THURSDAY, JANUARY 5, 1893.

SCIENTIFIC WORTHIES.

XXVIII.—Sir Archibald Geikie.

SOME MONTHS ago the British Association for the Advancement of Science was holding its annual meeting at Edinburgh under the presidency of Sir Archibald Geikie, F.R.S., Director-General of the Geological Survey of the United Kingdom.

It may well be said that a more appropriate choice could hardly have been made by the Council of the learned Association. Not only is Sir Archibald a thorough Scot, born and educated in Scotland, where he fulfilled for many years the most important duties as a member of the geological staff, and later as a professor in the University of Edinburgh, but, having long been engaged in the supervision of the Scottish Survey, he mapped with his own hand many hundreds of square miles of country, and through the entire scenery of Scotland there is not a single point with the peculiarities of which he did not make himself thoroughly familiar. His knowledge of the ground is not at all restricted to geological relations. In Sir Archibald the qualities of the geologist are combined with those of the enthusiastic lover of landscape, and his able pencil excels in drawing original sketches in which the outlines, peculiar shades, and, one might say, the general spirit of the scenery are fixed with the most striking accuracy. Obviously, therefore, he was the right man to be placed at the head of the Edinburgh meeting, which many prominent foreign investigators attended in the hope of afterwards travelling, both as tourists and as men of science, through the most interesting fields of the Highlands. Nobody could have been better fitted to introduce them to the country. When putting Sir Archibald in the chair at Edinburgh, the British Association not only did due justice to one of the most distinguished sons of "modern Athens," it also took the best course to secure from foreign guests the fullest recognition of the various merits of Scotland.

Sir Archibald Geikie was born at Edinburgh in 1838. We learn from a notice in the *Mining Journal* that he was educated at the Royal High School and at the Edinburgh University. When he was only twenty years old he became an assistant on the Geological Survey for Scotland, and proved so able that in 1867, when the Scottish branch of the Survey was made a separate establishment, Sir Roderick Murchison deemed he could not do better than confer the directorial powers on the young assistant whom he had appreciated at work. Four years later, the chair of Geology and Mineralogy at the University having been founded by Sir Roderick with a concurrent endowment by the Crown, Archibald Geikie was invested with the new professorship, which he resigned only at the beginning of 1881, when he was appointed to succeed Sir Andrew C. Ramsay as Director-General of the Geological Survey of the United Kingdom, and Director of the Museum of Practical Geology in Jermyn Street.

That the new Director had not disappointed the hopes he had excited, appeared with sufficient clearness when, some time ago, the Queen conferred on him the honour of knighthood. Now it is our duty to note the chief features of his activity, and to state what personal part Sir Archibald Geikie has played in the recent progress of science. It is scarcely necessary to say that his geological achievements are too important to be conveniently reviewed in a few lines. Nevertheless we shall try to give a general idea of the prominent results to which his name must be attached.

Early appointed, as he was, as an officer of Scotland's Survey, he had, from the beginning, to deal with the most puzzling problems involved in the stratigraphy of the Highlands. The case was a very difficult one, and gave rise to much controversy between Sir Roderick Murchison and many other geologists, among whom it will be sufficient to quote the respected name of Nicol. As in the Highlands gneisses and ordinary crystalline schists were seen resting, with apparent conformity, on Silurian strata, it had been admitted by Murchison that the sequence was a normal one Therefore the crystalline schists had to be regarded, in spite of their Archæan appearance, as metamorphosed Silurian deposits. Such an assumption had a considerable bearing on other geological problems, as it rendered highly probable the theory that the so-called primitive gneisses were altered sediments, and had nothing to do with the early crust of the molten globe.

That Sir Archibald should at first have taken his Director's side is not at all surprising. But he was never quite satisfied; and his love of truth led him, as soon as he was in a position to do so, to undertake a detailed review of the facts. Since the discovery of Silurian fossils in the rocks of N.W. Sutherland, it had been recognized that the key to the structure of the Scottish Highlands was to be searched for in that region. Accordingly, in the years 1883 and 1884, MM. Peach and Horne were entrusted with a careful study of the Durness and Eriboll districts. They were very far from being directed to obtain means of justifying the old survey. "It was a special injunction to the officers" (we quote Geikie's own words) "to divest themselves of any prepossession in favour of published views, and to map the actual facts in entire disregard of theory."

From the work ably carried on by the distinguished surveyors, and verified on the spot by the Director-General, it appeared clearly that Murchison had been deceived by prodigious terrestrial disturbances, of which, at the time, nobody could have formed an idea. Over immense reversed faults, termed *thrust planes* by Geikie and his officers, the older rocks on the upthrow side had been, as it were, pushed horizontally forward, covering much younger sediments; and the displacement attained the almost incredible distance of more than ten miles. Sometimes an outlier of the displaced ground was found capping a hill, while the remainder had been swept away by erosion, and the strangeness of the case led the observer to write, "One almost refuses to believe that the little outlier at the summit does not lie normally on the rocks below it, but on a nearly horizontal fault."

Disturbances of that kind had already been noticed in some coal-basins, as, for example, on the southern limit of the French and Belgian coal-field, where similar outliers had been termed by M. Gosselet "lambeaux de

poussée." But they occurred on a much smaller scale, and there was no reason why the phenomena should be considered otherwise than as quite exceptional. To recognize the generality of that class of stratigraphical accidents was a conquest of a high order, not only for Scottish geology, but for all countries where the work of orogenetic disturbances has for a long time suffered from the agencies of erosion. The Highlands of Scotland belong to that part of the old European continent which in earlier Palæozoic times emerged from the sea. Near the end of the Silurian period it was subjected to enormous pressure, which resulted in folding and breaking the whole border of the dry land, raising in the air a series of high mountainous ridges, the Caledonian chain of M. Suess. But millions of years have since passed over the land, and the continued action of atmospheric powers has left but a very small part of the original mass. It is extremely difficult, therefore, to restore the broken continuity; and through the quiet appearance of the now planed ground, the geologist is everywhere bound to search after the scattered signs of previous plication and fracture. This is now the task to be fulfilled by the detailed Survey, and every stratigraphical difficulty has to be treated in the newly-acquired light.

A few years after that discovery had been made in Scotland, Prof. Marcel Bertrand made in Southern France quite similar observations, showing that very limited patches of older formations, which had been till then regarded as remnants of ancient islets, projecting out of younger geological seas, were nothing else than outliers of reversed folds, the remainder of which had disappeared under the action of rain and rivers.

In this manner the correction of a long accepted error has led to stratigraphical conclusions of the highest import. In the meantime these gigantic displacements showed themselves accompanied by intense modifications of the rocks, so that Geikie was entitled to write: "In exchange for this abandoned belief, we are presented with startling new evidence of regional metamorphism on a colossal scale, and are admitted some way into the secret of the processes whereby it has been produced."

This is not the only occasion on which Sir Archibald has given proof of his readiness to admit frankly and decidedly the correction of opinions which have long been held. Some years ago, when the Lower Cambrian fauna had been detected by the officers of the Survey much below the Durness limestone of the Highlands, in a series of strata which rests unconformably on the Torridon sandstone, he was the first to announce the fact before the Geological Society. The "Precambrian," which he had till then been rather reluctant to recognize, has now taken its place in the scale of divisions. Moreover, he has created a new name, that of "Dalradian," for the long strip of Precambrian deposits which extends from Donegal to the centre and south-west of Scotland.

As one of the most characteristic formations in Scotland is the Old Red Sandstone, we cannot be surprised that Sir Archibald has devoted much care to the description of the peculiarities of that interesting group of strata. After a long and detailed study of the whole ground, he has summed up his views in some important memoirs, published in the Transactions of the Royal Society of Edinburgh. There he has called again to life the old and long-extinct lakes, where the grits and conglomerates of the Old Red were piled up through the disintegration of surrounding formations, namely, Lake Orcadie, Lake Caledonia, Lake Cheviot, Welsh Lake, and Lake of Lorne; each of them being a separate basin, where the work of sedimentation has been many times interrupted by volcanic outbursts, while in the adjacent and more quiet seas there were accumulated the marine deposits of Devonshire.

But the chief work of Sir Archibald seems to be his exhaustive review of the volcanic history of the British Isles. While his brother, Dr. James Geikie, the author of "The Great Ice Age," has done excellent service by deciphering the marks of former ice action on the soil of the United Kingdom, Sir Archibald has been particularly attracted by the work of fire, *i.e.* by the records of that volcanic activity, the evidence of which is so deeply impressed on the scenery of the Hebrides, of Wales, and other districts of Great Britain.

The British Isles are now a very quiet ground, where explosive activity and projection of stones seem to be restricted to electoral periods; and although Scotland has been from time to time shaken by minor earthquakes, no human eye has ever seen there any volcanic outburst. Nevertheless, during Tertiary times, immense sheets of lava were poured out in the north-west of the country. To discern the site of the centres of eruption, and determine the old chimneys, the remnants of which give a glimpse into the lowest parts of ascending lavas; to discriminate the volcanic *necks*, the intrusive sheets and dykes, the bedded lavas and the tuffs—this was the first part of the task undertaken by Sir Archibald. But it was not enough for him to re-ascend in the past to the beginning of the Tertiary period. Not only in the Old Red of Scotland, but in the very heart of the oldest formations known in England and Wales, there were numerous evidences of previous volcanic activity. To use Geikie's words: "Placed on the edge of a continent and the margin of a great ocean-basin, the site of Britain has lain along that critical border-zone where volcanic energy is more active and continuous."

The chief outlines of that marvellous story, which was hardly suspected some years ago, were recently traced in Geikie's presidential addresses to the Geological Society of London; a work which has been qualified by Mr. Iddings, the distinguished American petrographer, as "one of the most important contributions to the history of volcanic action." Nevertheless, it is only a preliminary paper, and in the same manner as he already has devoted a special memoir to the volcanic outbursts of Tertiary times, Sir Archibald promises to publish in a short time a detailed account of the Palæozoic eruptions.

In order to become competent for such an undertaking, the author had prepared himself without sparing time, labour, or trouble. Having travelled over much of Europe, from the north of Norway to the Lipari Islands, he was anxious to learn from personal observation the broad features of that American continent, the geological construction of which seems to have been conceived on a much larger scale than that of Europe. Therefore in 1878 he rambled over many hundreds of miles in Western America, from the Archæan fields of Canada to the huge volcanic plateaux of Oregon and

Idaho, where a country as large as France and Great Britain combined has been flooded with a continuous sheet of basalt. But stratigraphical studies were only part of the necessary initiation. Sir Archibald had been one of the first field-geologists in England to perceive the importance of microscopic investigation as an adjunct to field work. He might well have left the care of that special study to some officer in the Survey; but he wished to make himself master of the subject. Connected by personal friendship with Zirkel, Renard, and other eminent petrographers, he gave to that branch of the Survey such a vigorous impulse, that upwards of 5000 slices of British rocks were soon prepared and classed in the collections of the museum in Jermyn Street; and if he can now rely with full confidence on his distinguished professional officer, Mr. Harris Teall, for any determination of rocks, he himself has won all necessary competence in that department of science, which has been so much enlarged during the last twenty years.

An undertaking so ably provided for could not but prove successful. It is not, of course, our purpose to give an account of the results arrived at. The "History of Volcanic Action in the Area of the British Isles," as it was presented in the presidential addresses for the years 1891 and 1892, is so much condensed that it must be read *in extenso* by every one who takes interest in the matter. We would only call attention to the final summary, where some important and far-reaching conclusions are deduced from the observed facts. One of them is that British volcanoes have been active in sinking rather than in rising areas; to which it is added that the earlier eruptions of each period were generally more basic, while the later intrusions were more acid.

When presenting "a connected narrative of ascertained knowledge regarding the successive epochs of volcanic energy in this country," Sir Archibald did more than write an important chapter of British geology. It may be said that he definitively settled the long-controverted question, whether there has been any essential difference or not between the display of volcanic activity at various geological periods. Not very long ago some scientific schools—above all, on the Continent—showed the greatest reluctance to admit that true volcanoes could have existed during the Palæozoic era. When they were told of Cambrian lavas and felspathic ashes, of Silurian tuffs, especially of Precambrian felsites, they could not restrain a strong feeling of incredulity. Against old granitic or porphyritic eruptions they had nothing to object; but the volcanic *facies* appeared to them a privilege restricted to recent geological times. To this the present writer might bear personal testimony, as he found his "way of Damas" only when he was fortunate enough to ramble over North Wales, and gather with his own hands pieces of vesicular lava embedded in the tuffs of the Snowdon, or boulders of true felsite lying at the base of the Cambrian series at Llanberis.

Not only has Sir Archibald, in common with his countrymen, always escaped that kind of misconception, but he will have contributed more effectively than any other to place the matter in the true light. Thanks to the cliffs of Scotland, he has been able to trace the roots of old volcanoes, to show true volcanic bombs entombed in sediments, and to mark the site round which vast piles of lavas and tuffs, 5000 or 6000 feet in thickness, had been heaped up. Likewise, in his previous paper on Tertiary volcanoes, he had established by indisputable sketches that the granitic rocks of the islands of Mull and Skye were ejected during the earlier part of the Tertiary period, and that they belong to the central mass of intrusions, the lateral veins of which have taken the form of granophyres.

There is another kind of useful geological work which Sir Archibald has a right to be credited with; we allude to the restoration of the most friendly relations between the official Survey and the Geological Society of London. For many years those relations had been maintained at a rather low temperature; both independent geologists and Government's surveyors showed, as it were, more inclination to mutual and severe criticism than to brotherly co-operation. This period of misunderstanding is now well over. Thanks to the present Director, the Geological Society has more than once received the early flower of the capital results obtained by the Survey, and the recent Presidentship of Sir Archibald has solemnly sanctioned the return of a harmony which will prove of great benefit to the advancement of geological science in England.

This is a very brief and imperfect account of the chief work accomplished by the field-geologist, a work which would have been sufficient for the whole of a man's life. But we have now to consider in Sir Archibald the master who has been engaged in important educational duties. When he was appointed in 1871 to the chair of Geology at Edinburgh he had the whole work of that department to organize, a task which may be wearisome, but which involves great benefit for a man of labour, as he must face every difficulty, and obtain day by day a clear and personal idea of all that is required for teaching. To that we are indebted for the undisputed superiority which Sir Archibald has displayed in his "Text-book," as well as in his other educational writings, such as the "Class-Book," a very model of clearness, whereby it has been once more demonstrated that those only are qualified for writing elementary books, who are in the fullest possession of the whole matter. Likewise he is the author of small books or "primers" on physical geology and geography, of which some hundreds of thousands of copies have been sold, and which have been translated into most European languages as well as into some Asiatic tongues. This exceptional success will be easily understood if we remember that in Sir Archibald's works the traditional barrenness of geology is always smoothed and adorned by a deep and intense feeling for nature. Nobody has done more than he to associate geological science with the appreciation of scenery. In numberless writings he has undertaken to explain the origin of existing topographical features. Among others reference may be made to the volume on "The Scenery of Scotland viewed in connection with its Physical Geology," first published in 1869, of which a new edition appeared in 1887; also to "Geographical Evolution," in the Proceedings of the Royal Geographical Society for 1879; and "On the Origin of the Scenery of the British Isles," published in NATURE (vol. xxix. pp. 347, 396, 419, 442).

Nevertheless, whatever might have been the attainments of the geologist and of the teacher, they would not have been sufficient to secure universal recognition, had not Sir Archibald been provided in addition with the best powers as a writer. From the beginning he was strongly convinced of the importance of cultivating the literary element in scientific exposition, not only in order to make science interesting and intelligible to those outside the circle of actual workers, as he did in writing "Geological Sketches at Home and Abroad," but because he did not admit the right of a man of science to appear before the public without putting on the "nuptial dress." Every one who knows Sir Archibald will readily admit that in doing so he is not impelled by a desire for personal display. He is essentially a man of thought as well as of action. "*Res non verba*" might well serve him as mo tto, and whoever has seen his silent but piercing attention in listening to some scientific controversy would never be tempted to suspect him of a wish to search after resounding manifestations. But he has too much of the artist's temper to neglect correctness and elegance in the utterance of his thoughts. And since nothing in the world is less common than the union of scientific insight and acuteness with a vivid appreciation of nature and a delicate feeling for style, it is not strange that Sir Archibald's fame has passed far beyond the circle of professional men. The portrait will be duly completed when it is added that no one could have a better renown for frankness, fair dealing, and perfect trustworthiness in every relation of life.

It is highly gratifying for England that the recognition of such achievements has not been left to future times, and that the present generation has not failed in the duty of rewarding so much continuous and fruitful labour. He was admitted to the Roya Society before reaching the age of thirty, a most unusual honour; he has been Vice-President, and was recently elected Foreign Secretary, of that Society. Since 1890 an Associate of the Berlin Academy; elected by the Royal Society of Sciences at Göttingen, after the death of Studer, the Nestor of Swiss geologists; enrolled among the members of the Imperial Leopold-Caroline German Academy, of the Imp erial Society of Naturalists of Moscow, &c., &c., he was chosen in 1891 as a correspondent by the French Academy of Sciences, and in the same year he was made a knight. An honorary LL.D. of the Universities of St. Andrews and Edinburgh, he has received the Murchison medal of the Geological Society of London, and twice the MacDougal Brisbane Gold Medal of the Royal Society of Edinburgh has been conferred on him, in recognition of the zeal and skill displayed in explaining the geological peculiarities of his mother-land. He is now at the summit of his career, and not so heavily laden with years but that we may express for him the wish *ad multos annos*. Let us hope that he will long remain at the head of the distinguished staff to which he has given so profitable an impulse, and continue to serve as a comforting example for those who refuse to acknowledge any other means of genuine success than constant labour and faithfulness to duty.

A. DE LAPPARENT.

SHAKING THE FOUNDATIONS OF SCIENCE[1]

TO judge by the columns of the daily press, we must expect to find a large number of enterprising company-promoters coming forward shortly to urge, in Parliament and elsewhere, that leave may be given them to confer lasting benefits upon Londoners. The good they propose to do comes in the shape of underground intercommunication. Locomotives of the ordinary construction, it would seem, are not to be employed, but instead of them cable traction or electric energy in some shape or another. On these points, however, we must speak with caution, for we are told that an absence of definite statements and programmes is one of the main features of the pronouncements so far issued.

On two previous occasions it has been our duty to draw attention to a scheme, intended to provide more ready means of intercommunication between different parts of London, which threatens to inflict serious damage upon the property of the nation.

It so happens that one of the schemes to which reference was made in the opening paragraph is a rehabilitation and expansion of that very project against which we protested on the previous occasion. The attempt, which has already once been thwarted, to render the study of the sciences involving exact measurement impossible at South Kensington, is again to be repeated, and it is necessary to warn the public that an enterprise undertaken nominally for their interests, which are, or the moment, regarded as identical with those of the company-promoter, will strike a fatal blow at the utility of institutions on which many thousands of pounds of money, public and other, have already been spent, and on which it is in contemplation to spend many thousands more. Our protest on the former occasion was based on scientific grounds. There were others strongly urged from other points of view, and as a result of the opposition the scheme was withdrawn for a time.

In the shape it now assumes it is still more objectionable, as the scope is now a more ambitious one.

Our objection was simply to the route to be followed. In London we have only one locality where telescopes are nightly used by teachers and students; we have only one institution the function of which is limited to physical and chemical teaching and research, where delicate measurements are essential, and form part of the routine work; we have only one institution, the function of which is to teach applied science in the most efficient manner—that is, by teaching in which experiment and observation, and of extreme delicacy, must go hand in hand with the *viva voce* exposition of the professor of each branch of applied science.

The contemplated railway proposes to sweep all these away. Astronomical Observatories, the various Laboratories of the Royal College of Science, and of the City and Guilds Institute, are not to be considered the least in the world. This is practically what it comes to; for we doubt whether either teacher or taught will care to remain in a locality where neither valid experiments nor observations are possible.

[1] Continued from vol. xliii. p. 146.

We need not waste time in considering whether some means could not be found to continue to take astronomical photographs of say an hour's exposure, or to use chemical balances of the greatest delicacy, with a railway or tramway of any kind running intermittently within twenty yards of the laboratory in which the work is supposed to be carried on; and it is also clear that the result would be disastrous if the traffic were carried on at any practicable depth.

Last year a joint Committee of the Houses of Lords and Commons fully considered the question as to the principles on which future extensions of what may be called omnibus traffic should be carried on, and they came to the conclusion that electric and cable railways constructed at a considerable depth below the surface would probably be the most convenient means for uniting the various parts of the metropolis more closely.

Some people have attempted to read into this part of the Committee's report that given a cable or electric railway *there will be no shaking!* And it has been suggested that all such opposition as we have expressed above should disappear. This of course is the view of the company-promoter, but it will commend itself to no one else. In fact there are special objections to an electric railway in addition to those earthquakes more or less mitigated which are associated with any system of traction.

No evidence was laid before the Committee as to some of the disadvantages which are incidental to the use of electricity. It is true that these disadvantages are not such as to interfere with the further extension of electrical railways, but they are of sufficient importance to be considered in deciding on the routes which the railways shall follow. Experiments made some little time ago in the neighbourhood of the South London Electrical Railway proved that the electrical disturbances were so great that it was doubtful whether ordinary higher students' work could be carried on within a quarter of a mile.

A quarter of a mile! And the proposed railway, or electric way, or cable way, or tramway is to run within twenty yards of electrical and magnetic laboratories. "*Rien n'est sacré pour un sapeur!*" an evil hidden in the ground ceases to be one.

It must not be forgotten that the interests at stake are not only those of the higher sciences and research. It might, perhaps, be argued that as the instruments used for investigation become more sensitive, and as the necessity for accuracy increases, it may be necessary that researches of a special character should be carried out in places specially selected for their freedom from all external disturbance. A serious damage will, however, be done to our large towns if it becomes necessary for every middle-class youth who wants to master more than the elements of science to become a boarder at a country college. It is frequently complained that there is an increasing separation between class and class, those who are able to do so leaving the towns for the more distant suburbs. It would be a thousand pities if the higher education were also, even in part, to be banished from our great centres of population.

It may be urged by the promoters of the company that it will be easy for them or the Government to plant the Royal College of Science elsewhere, but if the buildings of the College are notoriously inadequate, it was clearly stated at the time when the proposal to place a collection of pictures on the site reserved for science made it necessary to explain the future policy of the Department of Science and Art, that the collections and the laboratories attached to them were in the future to be housed on the plot close to the present site.

But as stated before, it is not necessary only to base our case upon the injury which would certainly be done to the Royal College of Science; it must be remembered that hard by is the City and Guilds Central Institution, in which extensive and costly laboratories, built by the munificence of the City Companies, have during the last few years been filled with students, many of whom are engaged in advanced studies.

Every argument which applies to the one case holds good in the other. The work of the City Companies and the interests of these institutions are endangered in the same way, and for the same reasons, as those of the Government College over the way.

On the previous occasion, when it was proposed to bring a railway at the back of the Central Institution, the Professors there, with the sanction of the City and Guilds of London Institute, opposed the scheme. We understand that the Professors have again made a representation to the Institute which in all probability will result in steps being taken to prevent the construction of any railway or tramway which would interfere with the work carried out in the Physical Department of the Central Institution.

In both these institutions it is as important that the apparatus should be used without let or hindrance from external disturbances, as say, that the reading-room in the British Museum should not be rendered uninhabitable by a nuisance produced either by private individuals or by some company in the neighbourhood.

On these grounds we protest in the name of science against a railway of any kind in Exhibition Road.

If there is one district in the metropolis which ought to be thus secured, it is the neighbourhood of the great national scientific school and its associated collections.

And here a word about these Science Collections. There are philistines among us who think that the collections would do very well without the schools, as the schools could do very well without either higher teaching or research.

There is no doubt a certain advantage to be gained by collecting types of all sorts of apparatus, exhibiting them appropriately labelled in glass cases, through which the public may gaze with, it is to be feared, somewhat indiscriminate admiration; but it must always be recollected that the nation is proud of the British Museum and Art Galleries, not merely because they play a useful part in educating the crowds who visit them, but also because they are centres to which students resort from all parts, not only of the United Kingdom, but of the civilized world, not to gaze at the collections but to *use* them. In like manner a national collection of scientific apparatus should be brought together, not merely to be stared at, but to be used. By an arrangement more logical than those to which our haphazard English

customs too frequently lead, this second object is at present attained.

It is almost ludicrous that at the very moment when a Royal Commission is sitting to determine the constitution of a new University for London, Parliament should be asked to sanction a Bill which, if it serves as a precedent, may make the teaching of some of the most important sciences impossible within the metropolitan area. Indeed, in this danger we find a new confirmation of the importance of the policy which we have often urged upon those who are directly interested in the constitution of the future University.

Science teaching in Exhibition Road is threatened to-day. It may be threatened somewhere else to-morrow. It will be impossible for a number of competing colleges to defeat the railway engineers, or to preserve intact for scientific research a number of buildings planted upon sites selected without reference to the new danger which has arisen. They will be attacked in detail, and beaten one by one. How immensely in this, as in many other matters, would their position be strengthened if they were able to speak with one voice in support of a plan decided on in common, and defended together. If the hoped-for University of the future already existed; if it spoke with the prestige of the existing University of London, combined with that of the consolidated teaching staffs of the London Colleges; if the support of a Government Department could be asked to aid a University which, like the British Museum, commanded universal respect and support; then it might be possible to obtain a ready hearing for opinions given with all the weight of a great institution of which the country would be justly proud. Till the union is effected, which alone will make science in London able to meet its enemies in the gate, we must struggle as best we can to prevent irreparable mischief.

We can only hope that the Vice-President of the Council, who is known to have the interests of the higher education at heart, will not allow a railway, electrical or other, to injure the teaching institutions clustered round the magnificent collections of apparatus in his charge.

SOUND AND MUSIC.

Sound and Music. By the Rev. J. A. Zahm, C.S.C., Professor of Physics in the University of Notre Dame. Large octavo, 452 pages. (Chicago: A. C. McClurg and Company, 1892.)

THIS handsomely got-up and lavishly illustrated volume is, the author informs us, a largely expanded transcript of a course of lectures delivered by him, in 1891 "in the Catholic University of America, at Washington, D.C." Its "main purpose is to give musicians and general readers an exact knowledge, based on experiment, of the principles of acoustics, and to present at the same time a brief exposition of the physical basis of musical harmony." A clear intimation is given at the outset (p. 18) of the predominant *rôle* which experiment is to play in the acoustical portion of the undertaking. Had Prof. Zahm not had at his disposal "all the more delicate and important instruments" of research and verification, in the theory of sound, constructed by Dr. Koenig of Paris, he would "not have attempted to give the present lectures on sound" before such an audience as that which actually attended them. With Dr. Koenig's apparatus around him, however, he had assured means of "entertaining" his hearers, and of "illustrating in a way that would otherwise be impossible the most salient facts and phenomena of sound." The late Isaac Todhunter has deprecated the systematic repetition of perfectly established experiments, on the ground that their results ought to be believed on the statements of a tutor—"probably a clergyman of mature knowledge, recognised ability, and blameless character"—to suspect whom was in itself irrational.[1] Prof. Zahm's practice pushes to a great length a view directly opposed to that enunciated—with obvious humorous exaggeration—by the well-known Cambridge private tutor. Not content with a single experiment decisive of each successive issue presented, he performs a whole series bringing into action all the resources of his superbly found collection of acoustical apparatus. It is no detraction from the clear and interesting manner in which these formidably numerous experiments are set forth, to say that the amount of space necessarily devoted to explaining the mechanism of the apparatus used gives to parts of Prof. Zahm's volume somewhat of the look of an acoustical instrument-maker's illustrated catalogue. Subject, however, to this defect, if defect it be, the lectures are decidedly pleasant and attractive reading. The illustrations, too, are thoroughly clear and beautifully executed, so that our author may be fairly congratulated on success in 'entertaining'—the word is his own—his hearers and readers. His object, to give to general readers an "exact knowledge" of the principles of acoustics, has also been in a fair measure attained, but subject to certain not inconsiderable deductions. In describing the processes and results of experiment Prof. Zahm is clear and thoroughgoing: in expounding the parts of acoustical theory which must be mastered if the facts thus obtained are to be understood in their mutual relations, he is often vague and superficial. Thus the nature of wave-motion, the formation of stationary undulations, the composition of small vibratory movements—matters of crucial importance to any connected comprehension of Acoustics—receive from him no effective elucidation. Nay, he is even chargeable with having, by the misuse of a technical term of perfectly settled meaning, written in a way likely to confuse his readers' ideas on these very matters. On p. 46 he calls certain points in a series of progressive waves "NODAL points where there is no motion," thus confusing two things which ought to be most carefully distinguished from each other, a point of *momentary* rest in a *progressive wave*, and one of *permanent* rest in a *stationary undulation*. The usage which restricts 'node' to this latter meaning is so well established that such use of it as the above is quite inexcusable, especially in an author who himself elsewhere, p. 146 &c., employs it in its ordinary signification. The same indifference to accuracy of expression recurs in this volume with a frequency not creditable to a professor of an exact science. Thus on p. 50 the return movement of a prong of a tuning fork is said

[1] "The Conflict of Studies," p. 17.

to 'pull' air particles apart. On p. 52 we are told that the motions of particles of a water wave "are always at right angles to the direction of the wave itself." On p. 68 the author corrects this statement, but in doing so, takes occasion to speak of a plane "in," instead of 'passing through' the line of progression. On p. 380 he describes harmonic partial-tones as "modifying the quality of their fundamental," though he obviously means the quality of the compound sound due to the fundamental and other partial-tones combined. On p. 387 it is said that the "ratios of frequencies" which characterize particular sounds "are called intervals," and that by dividing one note by another we obtain the intervals between them. Language of this kind is, indeed, hardly misleading, but it is certainly very slipshod.

Before passing from the more generally acoustical, to the more specially musical portion of Prof. Zahm's volume, it is proper to point out one important respect in which it has the advantage over most, or possibly all, the manuals on the same subject which have preceded it. This merit consists in giving a somewhat full account of elaborate experimental researches on beats, combination-tones and quality conducted by Dr. Koenig, the results of which are to a considerable extent at variance with conclusions previously announced by Prof. Helmholtz. In the opinion of our author, Dr. Koenig is "one who, not excepting even the eminent German philosopher just mentioned (Helmholtz), has contributed more than any other person to the advancement of the science of acoustics" (p. 17). A more balanced judgment, while placing great reliance on Dr. Koenig's experimental skill and on the superlative excellence of the apparatus constructed by him, would probably attribute to Helmholtz's opinion a preponderant weight in interpreting and correlating the results of experiment. Be that, however, as it may, Prof. Zahm has done excellent service by popularizing the work so laboriously performed, and so modestly placed on record, by the eminent instrument-maker to whom no one who has put his hand to acoustical work can fail to be under considerable practical obligations.

The specifically musical are decidedly the least meritorious parts of our author's performance. The looseness of phraseology already complained of is here at its worst. On p. 166 we are told that a 'comma,' ($\frac{81}{80}$) is "the smallest interval used in music." A beginner might easily take this to mean that notes differing by only that interval were actually heard consecutively in a musical phrase—of course an absurd supposition. Very misleading, again, is the statement on p. 388 that tones, like major and minor tones, that differ from each other only by a comma "are considered in music to have the same value." The only rational meaning to be got out of it seems to be that *in the equally tempered scale* the distinction between major and minor tones is obliterated On p. 389 the notes of the diatonic scale, and their relations, in respect to rapidity of vibration "to one another," are set out, and it is added that all but the second and the seventh of the intervals thus indicated are consonant. The essential piece of information, that it is not the intervals formed by these notes with "one another," but with *the tonic*, that are in question, is withheld, and so the reader is left free to suppose *e.g.* that the tritone, F—B, is a consonance. On p. 390 the 'inversion' of intervals is mentioned without any explanation of its meaning.

Attention may well be called to a process of reasoning which occurs on pp. 388–390. Prof. Zahm abruptly introduces (p. 388) calculation by "frequency-ratios"; assumes, without attempt at proof, that addition of two semitones is performed by squaring the ratio $\frac{16}{15}$, and then remarks (p. 390) "From the foregoing we observe that the sum of two intervals is obtained by multiplying, not by adding their ratios together." An *assumption* in a *particular case* is thus made to do duty as a *general demonstration*.

On p. 396 we read that "so perfectly does the interval of the fifth answer the requirements of the ear that even unpractised singers find it quite natural to take a fifth to a chorus that does not quite suit the pitch of their voice." If, as this passage appears to suggest, practised singers in America find it still more natural to accompany melodies in consecutive fifths, wonderful effects may surely be expected from the choruses to be heard at the Chicago exhibition.

On p. 429 our author describes a diagram by Helmholtz as concerned with the transposition of an interval by an octave, whereas what it really deals with is the enlargement of the interval in question by the addition to it of an octave. On p. 430 he writes down, *as constituents of the chromatic scale of C*, the notes E♯, F♭, B♯ and C♭.

On p. 441, he tells us that in listening to such violin players as Joachim, Wilhelmj, and others "one can always hear distinctly the *Tartini*, or beat-tones, that add such richness and volume to violin music."

To gauge the amount of truth contained in this remark it suffices to bear in mind that in the case of most major, and of all minor consonant chords, Tartini's tones cause a *decided dissonance*. Players who made them 'always distinctly audible' would soon be reduced to permanent inaudibility themselves.

Prof. Zahm's volume is creditably free from misprints: the following have, however, been noted:

P. 23, l. 16 'period' for 'periods.'
P. 68, l. 21 'amplitude' for 'amplitudes.'
P. 90, l. 8 'Ajugari' for 'Agujari.'
P. 142, in diagram, B♯ for B_4.
P. 152, in diagram I, B♯ for B.
P. 388, ll. 11 and 12, G for F.

GERLAND'S ETHNOLOGICAL ATLAS.

Atlas der Völkerkunde. (Berghaus' Physikalischer Atlas, Abth. vii.). Bearbeitet von Dr. Georg Gerland, Professor a.d. Universität in Strassburg. (Gotha: Perthes, 1892.)

ANTHROPOLOGY owes much to Prof. Gerland, whose completion of the two last volumes of the late Prof. Waitz's "Anthropologie der Naturvölker" is a monument of that co-ordinated knowledge of fact which is the source of sound principle. His new "Atlas of Ethnology," while forming part of the great Physical Atlas of Berghaus, may be obtained and used as a separate work by anthro-

pologists, to whom it will be of great service in methodizing the vast and growing information with which they have to deal. This application of graphical method, it is true, has difficulties which even the greatest skill cannot altogether overcome, but Prof. Gerland may well be content with his success in making evident at a glance the characteristics of mankind, seen from many points of view. Their distribution over the earth, as thus made evident, may often lead straight on into theories of origin. The fifteen plates contain nearly fifty maps, each suggesting a principle, or showing where there is room for one.

Plate I. represents on two planiglobes the classification of human races as to skin and hair. Prof. Gerland does not even combine these two characteristics, and points out in his introductory remarks that any attempt to map out man into defined physical races is impossible, for such division does not exist in nature. Anthropologists of course know this, but care is not always taken to make it clear that race-types are not so much complete realities as statistical abstractions from partial realities, the various measurable characters of skull, limbs, complexion, hair-form, &c., combining and blending too intricately for absolute definition. I was struck by meeting lately in a popular book with a confident mention of the four distinct Aryan race-types, and it occurred to me that it would bring the statement down to its bearings to put one of Prof. Gerland's planiglobes before the author, desiring him to define and map out these varieties of mankind. Even in Gerland's broad general distinctions of complexion and hair, an anthropologist not thoroughly special on the anatomical side may find novelty and difficulty. The opinion that all native Americans are similar as to race is here strongly and probably with reason modified by the native Brazilians being separated on the complexion-map from other peoples of North and South America, and placed to match the Tartars and Chinese. What amount of evidence there is for placing the Berbers of North Africa under the same map-colour seems not so clear, but it is to be noticed that the same tint includes several more or less distinct grades in Broca's scale. An attempt is even made to separate the friz-haired negroids into classes according to the arrangement of their corkscrew-tufts of hair on the skin. Plate III., in two maps, classifies man according to his religious beliefs and customs, and here the prevalence of special rites offers instructive generalizations. Thus the American line which limits the smoking of tobacco as a religious ceremony, indicates the spread of this peculiar rite from some religious centre over an enormous area. No doubt it is rooted in nature, from the fact that its narcotic ecstasy brought the priest into direct visionary contact with the spirit-world. But none the less, it proves the religions of savage tribes, separated by great distances on the map, to be bound together by historical connexion. Not less remarkable is the compactness of the districts of Eastern Asia and the opposite Continent of America, where masks are used, apparently originally with religious significance Here again it is evident that we have to do not merely with independent growth from the human mind, but in some way with historical transmission. It must be remembered in using these maps, that they bind their author only to fact, and not to theoretical interpretation. This same plate maps out the immense districts whose natives have a myth of a deluge, the upheaving of the earth, &c., but it cannot distinguish in North and South America, for instance, between regions where deluge-myths are old, and those where they were introduced by the Jesuits a few generations ago. Plate IV., mapping out regions liable to special diseases, as malarious fevers, pestilence, cholera, yaws, &c., contains in a condensed form a vast collection of knowledge, bearing on anthropological arguments as to the relation of race to physical constitution, and thus opening into one of the great problems of the history of man. Plate V. classes out the varieties of human food, clothing, dwellings and occupations. Plate VI. and onward map out the distribution of nations and tribes at different periods as known to history, Plate XIV. being devoted to the distribution of languages over the world.

Anthropologists who keep this atlas at hand as a help in their work will by practice find out its merits and defects. The representation of the geographical distribution of arts and customs has long been a feature of the Pitt-Rivers Museum, where so far as possible each series, illustrating development and transmission of culture, is accompanied by a small world-map coloured to show the parts of the world it occupies. It is of course impossible to Prof. Gerland to work in such detail, involving as it would do hundreds of separate charts. He has to indicate his distributions on a moderate number of plates and mostly uses planiglobes, a projection which, after being neglected for generations, will, in its improved modern arrangement, certainly come into more general favour. On these, by ingenious devices of tinted patches and streaks, combined with lines and dots, he succeeds in giving a more general survey of man and civilization than our students have ever had in their hands before. EDWARD B. TYLOR.

OUR BOOK SHELF.

Castorologia; or, The History and Traditions of the Canadian Beaver. By Horace Martin, F.Z.S. (London: Stanford, 1892.)

"BEAVER" was once the most important fur in the world. In former days the pelt of this Rodent was the standard by which all barter in the Dominion of Canada was regulated, and "beaver" passed as current coin throughout the whole of North America. Even now the quantity of beaver skins brought to England is considerable. Mr. Poland, in his "Fur-bearing Animals," tells us that upwards of 63,000 beaver skins were sold by the Hudson's Bay Company in 1891. But "beaver-hats" formerly required a much larger supply than this, and in 1743 it is said that 127,000 beaver-skins were imported into La Rochelle alone. Our "top" hats are now made of silk, and beaver has become a fur of second-rate importance.

Besides the fur of the beaver many other points of interest attached to this animal will be found discussed more or less completely in Mr. Martin's volume. Long before its fur was required for hats *castoreum* or castorin—a substance found in two large glands, situated near the base of the beaver's tail—was a much-valued specific in medicine, as spoken of by Hippocrates and Pliny. Even at the present time its use is by no means abandoned, and the "crude article" is "still sold at our drug-stores" at prices varying "from eight to ten dollars a

pound." But in past centuries castoreum was considered a sovereign remedy for every kind of disease. Many amusing details on this part of the subject are given by Mr. Martin, mostly extracted from the "Castorologia" of Johannes Francus, published in 1685. The wisdom of Solomon himself is attributed by this learned author to the virtues of the beaver. To acquire it, it is only necessary "to wear a hat of beaver's skin, to rub the head and spine with that animal's oil, and to take twice a year the weight of a gold crown piece of castoreum."

At the end of his volume Mr. Martin places a short account by Mr. C. V. Riley, the well-known American entomologist, of *Platypsillus castoris*, a parasite on the beaver, and one of the most remarkable among the many extraordinary forms of parasitic insects. Mr. Riley correctly refers this creature to the coleoptera, although other naturalists, and, amongst others, its discoverer, Ritsema, have expressed different views on this point He omits, however, to refer to the excellent account of *Platypsillus castoris*, written by the late John Leconte, and published in the Proceedings of the Zoological Society of London for 1872. Dr. Leconte has here shown that it is necessary to make a special family (Platypsillidæ) for the reception of this curious parasite, but that it must be unquestionably referred to the coleoptera.

On account of these and other peculiarities the beaver is unquestionably an animal of great general interest, and Mr. Martin has done well to devote a volume to what is evidently his favourite theme. There is, we must allow, little, if anything, original in it, and the statements on scientific points cannot always be implicitly depended upon. But the author has brought together a large amount of information on the subject, and his book is "popularly written" and "fully illustrated," though we cannot quite agree to his claims to have produced an "exhaustive monograph."

An Atlas of Astronomy. By Sir Robert Stawell Ball, LL.D., F.R.S. (London: George Philip and Son, 1892.)

A NEW book by Sir Robert Ball is always a matter of interest, but the present one naturally lacks the usual characteristics. It is described as "a series of 72 plates with introduction and index." In addition to monthly and general maps of the stars, the atlas reproduces pictures of the sun, moon, planets, and comets, and contains diagrams illustrating their motions and dimensions. As the book is chiefly meant to be a companion to more general works, the introductory matter is purposely brief, but still it has several features of interest. Special attention may be drawn to the excellent description of a simple graphical method of determining the orbit of a binary star.

To the serious student who may possess a small telescope the new atlas will be very useful. Here he may learn how to determine the positions of sun spots, how to find the places occupied by the various planets, and what objects are most likely to be within reach of his instrument. Those interested in selenography will derive much assistance from the twelve plates showing the moon at different phases, which have been specially drawn by Mr. E ger, each being accompanied by an index map. One can only wonder, however, that some of the recent excellent photographs of the moon have not been pressed into the service.

The star maps, on the whole, are excellent, and our only complaint is of the excessive density of the Milky Way, which, in some parts of the maps, is almost sufficient to obliterate the names and numbers of the stars. The monthly maps will be particularly useful to those who are just learning the constellations, a new feature being a belt indicating the track of the planets.

Spectroscopic astronomy is entirely omitted, the author being of opinion that this great branch of work can only receive justice in a separate atlas. In this we heartily agree, and trust that such an atlas will soon be forthcoming.

The author's large following of readers will no doubt welcome the new comer, but we must express regret that astronomical photographs are not more fully represented. It would be interesting, for example, to reproduce a series of photographs of typical nebulæ, all of which, we believe, are now available. A plate showing the advantages of photography in the delineation of stars would also add to the interest of the atlas.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Vector Analysis.

I FANCIED that, in reply to the voluminous letters of Prof. Willard Gibbs (NATURE, xliii. 511; xliv. 79), I had said in a few words all that is requisite (if, indeed anything *be* requisite) to show the necessary impotence, as well as the inevitable unwieldiness, of every system of (so-called) *Vector Analysis* which does not recognize as its most important feature the product (or the quotient) of two vectors:—*i.e.* a Quaternion.

A recent perusal of the first four pages of a memoir by Mr. O. Heaviside (*Phil. Trans.* 1892):—for so far only could I go:—has dispelled the illusion. For he calls the correspondence just spoken of a "rather one-sided discussion":—a truly Delphic delivery:—cleared up, however, by what follows it. I particularly desired to read the memoir (which the Author had kindly sent me) as I hoped to learn from it something new in Electrodynamics. But, on the fifth page, I met the check-taker as it were:—and found that I must pay before I could go further. I found that I should not only have to unlearn Quaternions (in whose disfavour much is said) but also to learn a new and most uncouth parody of notations long familiar to me; so I had to relinquish the attempt. In the last of the four pages of my progress, I had found that Mr. Heaviside (though, as above stated, he has a system of his own) is an admirer of Prof. Gibbs' system, to such an extent at least that he thinks "his treatment of the linear vector operator specially deserving of notice." There I was content to leave the matter.

But Mr. Heaviside has just published (*Electrician*, 9/12/92) an elaborate attack on Quaternions, of a kind which is calculated to do real injury to beginners. In answer to his remarks, in which he continues to point to me as the persistent advocate of a system which all right-minded physicists should avoid, I would simply refer him (and his readers, if there be such) to a brief Address which I gave a short time ago to the Physical Society of Edinburgh University (*Phil. Mag.* Jan. 1890). One or two sentences, alone, I will quote here:—

"if we can find a language which secures, to an unparalleled extent, compactness and elegance, and at the same time is transcendently expressive—bearing its full meaning on its face—it is surely foolish, at least, not to make habitual use of it."

"For (Hamilton) the most complex trains of formulæ, of the most artificial kind, had no secrets:—he was one of the very few who could afford to dispense with simplifications: yet, when he had tried quaternions, he threw over all other methods in their favour, devoting almost exclusively to their development the last twenty years of an exceedingly active life."

The main object, however, of my present letter, is to call attention to a paper by Dr. Knott, recently read before the Royal Society of Edinburgh. Dr. Knott has actually had the courage to *read* the pamphlets of Gibbs and Heaviside; and, after an arduous journey through these trackless jungles, has emerged a more resolute supporter of Quaternions than when he entered. He has revealed the (from me at least) hitherto hidden mysteries of the Dyadic, and of Prof. Gibbs' strange symbols Pot, Lap, Max, New, &c. The first turns out to be only the linear and vector function; and the others are merely more or less distressing symptoms characteristic of imperfect digestion or assimilation of ∇. And when, at my request, Dr. Knott

translated into intelligible form the various terms of one of the less formidable formulæ of Mr. Heaviside's memoir, I was surprized to find two old and very unpretending friends masquerading in one person like a pantomime Blunderbore. In one of his Avatars the monster contains, besides the enclosing brackets, no fewer than 24 letters, 12 suffixes, 3 points, and 5 signs! When he next appears he has still the brackets to hold him together, but although he has now only 18 letters, he makes up his full tale of 44 (or 46) symbols; for he has 9 suffixes, 3 indices, 3 points, 5 signs, and 3 *pairs* of parentheses! I used to know him as compounded of 14 separate marks only, viz.:— $V^2\nabla\sigma + 2S\nabla\nabla_1 S\sigma\sigma_1$:—but, unless I had required to dissect him, I should never have put him in anything resembling his new guise.

Dr. Knott's paper is, throughout, interesting and instructive:—it is a complete exposure of the retensions and defects of the (so-called) Vector Systems. "Wer diesen Schleier hebt soll Wahrheit schauen!" I find it difficult to decide whether the impression its revelations have left on me is that of mere amused disappointment, or of mingled astonishment and pity.

P. G. TAIT.

Edinburgh, 24/12/92.

Measurement of Distances of Binary Stars.

WITH reference to Mr. C. E. Stromeyer's letter on the above subject, which appeared on p. 199, it may be of interest to point out that his plan of determining the distance of a binary star is by no means a new one.

The method was, I think, first suggested by Mr. Fox Talbot at the Edinburgh meeting of the British Association in 1871; but the mere idea was sufficiently obvious as soon as the possibility of determining velocities by the spectroscope had been demonstrated by Dr. Huggins.

The first discussion of the geometrical conditions of the problem was given by Prof. C. Niven in the *Monthly Notices*, vol. xxxiv. No. 7, where he exhibits the relation connecting the parallax, the relative velocity, and the elements of the orbit of a double star, and computes the value of the product (πV) of the parallax and velocity for a small number of binary systems.

In a paper published in the Proceedings of the Royal Irish Academy for May, 1886, I examined the same question from a slightly different point of view, being at the time unaware of Prof. Niven's paper, and was led to similar results. An epitome of this paper was published in your Astronomical Column, vol. xxxiv. p. 206. From the results obtained it appeared that, all things considered, γ-Coronæ Australis and α-Centauri were the most likely binaries to yield to this method of eliciting the secret of their parallax, while α-Geminorum, one of the stars selected by Mr. Stromeyer, was shown to be most unfavourable on account of the situation of its orbit.

In the *Monthly Notices* for March, 1890, I again drew attention to the subject in view of the accuracy of the results obtained by the photographic method in the hands of Prof. Pickering and Prof. Vogel. In this paper I gave an extended list of binaries with the usual geometrical and dynamical elements, and in addition the two elements A and B on which the relative velocity depends. I also gave the greatest value which πV can attain in each case and the velocity to be expected in the case of those stars whose parallaxes had been determined.

Again in Mr. J. E. Gore's valuable catalogue of Binary Star Orbits, published in the Proceedings of the Royal Irish Academy for June, 1890, columns 18 and 19 are devoted to the constants A and B computed from my formulæ (which I may say ought more properly to be called Prof. Niven's formulæ on account of the priority of his paper) for eighty-one different orbits.

The subject has also been discussed by Miss Clerke in "The System of the Stars," pp. 199–201, where references to most of the original publications will be found.

I may perhaps add that the inverse problem of determining the elements of the orbit from spectroscopic observations alone has also been investigated by me in the *Monthly Notices*, vol. li. No. 5, where I have deduced the principal elements of the orbit of β-Aurigæ, a spectroscopic double which no telescope can divide.

I have been disappointed that astronomers engaged on spectroscopic determinations of stellar velocities have not devoted more attention to observations of already known binaries, which appear to me to offer a promising field of work, and have often regretted that at this observatory we have not the means of undertaking the investigation, and if Mr. Stromeyer's letter has no other effect than to bring the subject once more forward it will have done good service, but I should like to point out that the second of the stars selected by him ought on no account to be taken as a test of the feasibility of the method, since the accurate discussion of the conditions shows that unless this is an exceptionally remote system the velocity must be very small indeed. For instance, assuming Johnson's parallax, viz. 0″·20, the relative velocity of the components amounted last year to only 0·6 miles per second.

In the northern hemisphere the most favourably situated binaries are 70 Ophiuchi, ξ-Ursæ Majoris, and, if Peters' orbit represents the real motion of the pair, 61 Cygni; while for the southern hemisphere special attention ought to be directed to α-Centauri and γ-Coronæ Australis.

In Mr. Gore's Catalogue, referred to above, will be found all the materials for determining when to observe any known binary most favourably in this respect, and for deducing its parallax from the measures obtained, and it ought to be borne in mind before letting the subject sink back once more into oblivion, that, other things being equal, this method is most likely to succeed in the case of the most distant systems, where the parallax is so small that the ordinary trigonometrical method necessarily fails us, and that when the micrometer, the heliometer, and the stellar photograph break down, the spectroscope will sound the further depths with ever-increasing facility.

Dunsink Observatory, co. Dublin. ARTHUR A. RAMBAUT.
December 30.

December Meteors (Geminids).

THESE meteors were moderately abundant on the night of December 12, which appears to have been a very favourable one in regard to weather. The chief radiant point was observed in the normal position very close to α Geminorum, and there was a strong contemporary shower from a centre east of β Geminorum.

At 10h. 10m. December 12, a fireball estimated to be twice as brilliant as Venus was observed by Mr. Booth at Leeds. It moved rather slowly from 150°+43° to 188°+41°, and divided into two pieces at the finish.

Mr. Wm. Burrows, of Small Lane, Ormskirk, writes to me with reference to a meteorite which he observed to fall at a later hour on the same night. He says the time was 6.52 a.m. (December 13), and refers to the phenomenon as follows:—"Seeing the meteor was coming to the earth I crossed the road to where it appeared to be falling, and it fell about two yards from me. When it struck the earth it made a noise like the report of a gun; it also went black instantly. While descending it had a tail of fire about a foot long. It is 1$\frac{3}{4}$ inch in diameter one way, and 1$\frac{1}{4}$ inch another, and one inch thick."

Mr. Burrows sends drawings of the object, and it being still in his possession it is hoped the matter may be suitably investigated. Should it prove a veritable meteorite one interesting circumstance in connection with it will be that its descent took place concurrently with the shower of Geminids.

It is significant that December 9–13 constitutes a well-defined æroliiic epoch, rendered memorable by the fall at Wold Cottage, Thwing, Yorkshire, on December 13, 1795, and by many others, such as that at Mässing, Bavaria, December 13, 1803, at Weston, Connecticut, U.S.A., December 14, 1807; at Wiborg, Finland, December 13, 1813; at Ausson, France, December 9, 1858; at Baudong, Java, December 10, 1871, &c.

Bristol, January 1. W. F. DENNING.

The Earth's Age.

As Dr. Wallace (NATURE, p. 175) trusts "that on further consideration" I shall "admit that" my "objection is invalid," it is evident that I have failed to make clear to him my argument showing that his data do not warrant his conclusion.

He overlooks the fact that a thickness of 177,200 feet of sedimentary rocks is, standing alone, a perfectly indefinite quantity; to make it definite it must have a definite area.

As he mentions no area for it we are justified in assuming that he means the land area of the globe, whereas his calculation is made as though area were not of the essence of the problem, in short, as if the formation of a pile of sediment 177,200 feet thick, of no matter what area, were the problem.

In Sir A. Geikie's calculation and all other similar ones with which I am acquainted, the thickness of the sedimentary rocks is tacitly assumed to be their thickness all over the land area of the globe.

Dr. Wallace's calculation leads to the absurd result that continents are growing nineteen times as fast as materials are produced to supply their growth.

Leaving the question of the conclusions to which Dr. Wallace's data logically lead, I may say that I am not responsible, and do not hold him to be responsible, for the absurd theory as to the thickness of sedimentary rocks on which they are based.

In order to arrive at a scientifically accurate result, what we require to know is the present actual thickness in every part of the world, plus all the thickness which has previously existed in, but since been denuded away from, every area. The existing thickness in geologically explored areas can perhaps be ascertained within certain limits of error from geological maps and memoirs. For instance where the surface consists of Torridon Sandstone overlying Archæan gneiss of igneous origin, the thickness of sedimentary rock is that of the Torridon Sandstone only, if we assume that the gneiss there is part of the metamorphosed original crust of the earth, for the existence of which Rosenbusch has recently argued.

It is easily demonstrable, first, that in many places the existing thickness of each formation, where undenuded, is far from being the maximum thickness, and, secondly, from the thinning out in some directions, or merging, near the old shoreline, into conglomerates, that some formations were never deposited over certain areas; indeed, the very existence of a sedimentary deposit necessarily implies that of land undergoing denudation and not receiving deposit, although it may well be doubted whether the land area was always nineteen times the area receiving deposit.

Reasoning from the deposits preserved as to those removed by denudation, it is highly improbable that any considerable area ever received either the complete series of deposits, or on the average anything like the maximum thickness of the deposits it actually received. In addition to this, some formations usually considered to be successive may be really contemporaneous, so that the figures representing maximum thicknesses usually taken in calculating the earth's age are probably far above the truth for the purpose in question.

The immense labour involved in calculating the existing thickness of sedimentary rocks in each area, and the thickness which there is any reasonable ground for supposing to have been at any time denuded from that area, as well as the uncertainty of the results, has probably deterred geologists from attempting the task, especially as large areas are very imperfectly known. BERNARD HOBSON.

Tapton Elms, Sheffield, December 24.

THE first part of Mr. Hobson's letter alone requires notice from me, as the latter part characterizes as absurd the views of those eminent geologists who have estimated the total thickness of the sedimentary rocks, and seems to assume that such writers as the late Dr. Croll and Sir Andrew Ramsay overlooked the very obvious considerations he sets forth.

As regards myself, he reiterates the statement that when geologists have estimated the total thickness of the sedimentary rocks at 177,200 feet, they mean that this amount of sediment has covered the whole land surface of the globe; that, for example, the coal measures, the lias, the chalk, the greensand, the London clay, &c., &c., were each deposited over the whole of the continents, since it is by adding together the thicknesses of these and all other strata that the figure 177,200 feet (equal to 33 miles) has been obtained.

Mr. Hobson concludes with what he seems to think is a *reductio ad absurdum*:—"Dr. Wallace's calculation leads to the absurd result that continents are growing nineteen times as fast as materials are produced to supply their growth."

But the apparent absurdity arises from the absence of any definition of the "growth of continents," and also from supposing that the growth of continents is the problem under discussion. The question is, as to the growth in thickness, of sedimentary deposits such as those which form the geological series. These deposits are each laid down on an area very much smaller than the whole surface of the continent from the denudation of which they are formed. They are therefore necessarily very much thicker than the average thickness of the denuded layer, and the ratio of the area of denudation to the area of deposition, which I have estimated at 19 to 1, gives their proportionate thickness. If Mr. Hobson still maintains that he is right, he can only prove it by adducing *evidence* that every component of the series of sedimentary rocks has once covered the whole land-surface of the globe; not by assuming that it has done so, and characterizing the teaching of all geologists to the contrary as absurd. ALFRED R. WALLACE.

Ancient Ice Ages.

MR. READE in his letter (NATURE, p. 174) refers to the striations on the pebbles forming the conglomerates at Abberley and the Clent Hills.

Following the late Sir Andrew Ramsay, he considers the deposits to be of glacial origin, but goes further than that distinguished geologist in citing them as proof of a former ice age.

It is but reasonable to suppose that *glaciers* existed in past ages in places where the conditions—such as high altitude and abundant precipitation—were favourable.

Before, however, the existence of a former *glacial period* can be established, we must have evidence of contemporaneous deposits of undoubtedly glacial origin, and extending over widespread areas—say half a hemisphere. J. LOMAS.

University College, Liverpool, December 31.

Printing Mathematics.

THE use of the solidus in printing fractions has been advocated by authorities of such weight that it seems almost a heresy to call it into question. Yet I venture to think that there is a good deal to be said against it. In such matters the course preferred by mathematical writers and their printers is apt to take precedence over that which is most convenient for the great body of those who will read their work. It is tacitly assumed by those who prefer this notation that the getting of mathematical formulæ into line with ordinary printing is an unmixed advantage. No doubt it is easier to set up the work in type thus, but with the consequent rapidity and cheapness of printing the advantage ends. Most people will agree that it is much pleasanter to read a mathematical book in which the letterpress is well spaced, so that the formulæ stand out clearly from the explanatory language, than one in which the two run together in an unbroken stream: just as a book divided into paragraphs is more readable than one which is not. The old style is more restful to the mind and eye, and one can more readily pick out the salient features of the demonstration.

Another aspect of the question seems to me more important. In making any calculation mentally it is much easier to visualize fractions, more especially if complicated, as written in the ordinary way than as written with the new-fashioned notation. The component parts of the mental picture are imagined as spread over a plane instead of being arranged along a line, and can be thought of separately with less confusion. From a similar point of view it will be admitted that it is inconvenient to write mathematical expressions in one form and to print them in another.

Then, again, I doubt whether the assumption that the solidus notation conduces to accuracy is justified. No doubt the printer makes fewer original errors; but whereas with the old notation his frequent glaring errors are more readily detected by the proof-reader (or, if missed by him, by the ordinary reader), with the new notation the misplacement or omission of a solidus is, from the simplicity of the error, likely to be overlooked. In general, no one will be the poorer if a little more trouble is taken with the printing, and a little more paper is used for the book.

The symbol $/$ has advantages over its equivalent $\div$, and to its restricted use, such as is made by Sir G. Stokes, one can hardly object; it matters little how such expressions as a/b or dy/dx are printed. But it is the thin end of the wedge; and one is under a debt of gratitude to Mr. Cassie for showing, in your issue of November 3, to what it may lead. May it be a long time before we have to learn to substitute for the harmless expression, $\frac{b^{\frac{1}{2}}}{c(d+e)^3}$ its newest equivalent, $\lfloor b \setminus 1 / 2 \rfloor / c \lfloor d + e \setminus 3 \rfloor$! I trust that no one will interpret the final note of exclamation as a factorial symbol. M. J. JACKSON.

D. I. Sind College, Karachi, November 23.

The Teaching of Botany.

I DO not think there is at present any book in English giving practical instructions for experiments in Physiological Botany. There is, however, an excellent book of this kind in German, Dr. W. Detmer's "Das pflanzen-physiologische Praktikum," published by Gustav Fischer, Jena, 1888. This, no doubt, contains all that your correspondent "A. H." (NATURE, *ante*, p. 151) requires, though it is perhaps somewhat more advanced than is necessary for school teaching. D. H. SCOTT.

Old Palace, Richmond, Surrey.

THE ORIGIN OF THE YEAR.[1]

IV.

THE reformation of the Egyptian calendar, to be gathered, as I suggested in my last article, from the decree of Tanis, is not, however, the point to which reference is generally made in connection with the decree. The attempt recorded by it to get rid of the vague year is generally dwelt on.

Although the system of reckoning which was based on the vague year had advantages with which it has not been sufficiently credited, undoubtedly it had its drawbacks.

The tetramenes, with their special symbolism of flood, seed, and harvest time, had apparently all meant each in turn; however, the meanings of the signs were changed, the "winter season" occurred in this way in the height of summer, the "sowing time" when the whole land was inundated, and there was no land to plant, and so on. Each festival, too, swept through the year. Still, it is quite certain that information was given by the priests each year in advance, so that agriculture did not suffer; for if this had not been done, the system, instead of dying hard, as it did, would have been abolished thousands of years before.

Before I proceed to state shortly what happened with regard to the fixing of the year, it will be convenient here to state a suggestion that has occurred to me, on astronomical grounds, with regard to the initial change of sign.

It is to be noted that in the old tables of the months, instead of Sirius leading the year, we have Tεχi with the two eathers of Amen. In later times this is changed to Sirius.

I believe it is generally acknowledged that the month tables at the Ramesseum is the oldest one we have; there is a variant at Edfu. They both run as follows, and no doubt they had their origin when a 1st Thoth coincided with an heliacal rising and Nile flood.

Egyptian month.	Tropical month.	Ramesseum.	Edfu.
Thoth	June–July	Tεχi	Tεχ
Phaophi	July–Aug.	Ptah (Ptah-res-aneb-f)	Ptah (Menχ)
Athyr	Aug.–Sep.	Hathor	?
Choiak	Sep.–Oct.	Paχt	Kehek
Tybi	Oct.–Nov.	Mîn	Set-but
Mechir	Nov.–Dec.	Jackal (reḳḥ-ur)	Hippopotamus (reḳḥur)
Phamenoth	Dec.–Jan.	,, (reḳḥ-netches)	Hippopotamus (reḳḥ-netches)
Pharmuthi	Jan.–Feb.	Rennuti	Renen
Pachon	Feb.–Mar.	χensu	χensu
Payni	Mar.–Ap.	Horus (χonti)	Horus (Hor-χent-χati)
Epiphi	Ap.–May	Âpet	Âpet
Mesori	May–June	Horus (Hor-m-χut)	Horus (Hor-ra-m-χut)

I am informed that Tεχi, in the above month-list, has some relation to Thoth. In the early month-list the goddess is represented with the two feathers of Amen, and in this early stage I fancy we can recognize her as Amen-t; but in later copies of the table the symbol is changed to that of *Sirius*. This, then, looks like a change of cult depending upon the introduction of a new star—that is, a star indicating by its heliacal rising the Nile rise after the one first used had become useless for such a purpose.

I have said that the Ramesseum month list is probably the oldest one we have. It is considered by some to date only from Ramses II., and to indicate a fixed year; such, however, is not Krall's opinion.[1] He writes:—

"The latest investigations of Dümichen show that the calendar of Medinet-Abu is only a copy of the original composed under Ramses II. about 120 years before. . . .

"But the true original of the calendar of Medinet-Abu does not even date from the time of Ramses II. It is known to every Egyptologist how little the time of the Ramessids produced what was truly original, how much just this time restricted itself to a reproduction of the traditions of previous generations. In the calendar of Medinet-Abu we have (p. 48) not a fixed year instituted under Ramses II., but the normal year of the old time, the vague year, as it was, to use Dschewhari's words quoted above (p. 852), in the first year of its institution, the year as it was before the Egyptians had made two unwelcome observations: First, that the year of 365 days did not correspond to the reality, but shifted by one day in four years with regard to the seasons; secondly—which of course took a much longer time—that the rising of Sirius ceased to coincide with the beginning of the Nile flood.

"We are led to the same conclusion by a consideration of the festivals given in the calendar of Medinet-Abu. They are almost without exception the festivals which we have found in our previous investigation of the calendars of Esne and Edfu to be attached to the same days. We know already the Uaya festival of the 17th and 18th Thoth, the festival of Hermes of the 19th Thoth, the great feast of Amen beginning on the 19th Paophi, the Osiris festivals of the last decade of Choiak, and that of the coronation of Horus on the 1st Tybi.

"Festivals somehow differing from the ancient traditions, and general usage are unknown in the calendar of Medinet-Abu, and it is just such festivals which have enabled us to trace fixed years in the calendars of Edfu and Esne.

"We are as little justified in considering the mythologico-astronomical representations and inscriptions on the graves of the time of the Ramessids as founded on a fixed year, as we can do this in the case of the Medinet-Abu calendar. In this the astronomical element of the calendar is quite overgrown by the mythological. Not only was the daily and yearly course of the sun a most important event for the Egyptian astronomer, but the priest also had in his sacred books many mythological records concerning the god Rā, which had to be taken into account in these representations. The mythological ideas dated from the oldest periods of Egyptian history; we shall, therefore, be obliged for their explanation not to remain in the 13th or 14th century before Christ, but to ascend into previous centuries; *I should think about the middle of the fourth millennium before Christ, that is the time at which the true original of the Medinet-Abu calendar was framed.* Further we must in these mythological and astronomical representations not overlook the fact that we cannot expect them to show mathematical accuracy—that, on the contrary, if that is a consideration, we must proceed with the greatest caution. We know now how inexact were the representations and texts of tombs, especially where the Egyptian artist could suppose that no human eye would inspect his work; we also know how often representations stop short for want of room, and how much the contents were mutilated for the sake of symmetry."

[1] Continued from p. 35.

[1] *Op. cit.* p. 48.

There is also, as I have indicated, temple evidence that Sirius was not the first star utilized as a herald of sunrise. We have then this possibility to explain the variation from the true meaning of the signs in Ramessid times.

And it may be gathered from this that the Calendar was reorganized[1] when the Sirius worship came in and that the change effected in 619 B.C. brought the hieroglyphic signs back to their natural meaning and first use.

Before I pass on it may be convenient in connection with the above month-tables to refer in the briefest way to the mythology relating to the yearly movement of the sun, in order to show that when this question is considered at all, if it helps us with regard to the mythology connected with the rising and setting of stars, it will as assuredly help us with regard to the mythology of the various changes which occur throughout the year.

We have, as we have seen, in the Egyptian year really the prototype of our own. The Egyptians, thousands of years ago, had an almost perfect year containing twelve months, but instead of four seasons they had three, the time of the sowing, the time of the harvest, and the time of the inundation. Unfortunately, at various times in Egyptian history, the symbols for the tetramenes seem to have got changed.

The above-given inscriptions show that they had a distinct symbolism for each of the months. Gods or goddesses are given for ten months out of the twelve, and where we have not these, we have the hippopotamus (or the pig) and the jackal, two circumpolar constellations. I think there is no question that we are dealing here with these constellations, though the figures have been supposed to represent something quite different.

There are also myths and symbols of the twelve changes during the twelve hours of the day; the sun being figured as a child at rising, as an old man when setting in the evening. These ideas were also transferred to the annual motion of the sun. In Macrobius, as quoted by Krall, we find the statement that the Egyptians compared the yearly course of the sun also with the phases of human life.

Little child	=	Winter solstice.
Young man	=	Spring equinox.
Bearded man	=	Summer solstice.
Old man	=	Autumnal equinox.

With the day of the summer solstice the sun reaches the greatest northern rising amplitude, and at the winter solstice its greatest southern amplitude. By the solstices the year is divided into two approximately equal parts; during the one the points of rising move southwards, during the other northwards.

This phenomenon, it is stated, was symbolized by the two eyes of Rā, the so-called Utchats, which look in different directions. They appear as representing the sun in the two halves of the year.

We have next to discuss the fixed year, to which the Egyptian chronologists were finally driven in later Egyptian times.

The decree of Tanis was the true precursor of the Julian correction of the calendar. In consequence of this correction *we* now add a day every four years to the end of February. The decree regulated the addition, by the Egyptians, of a day every four years by adding a day to the epacts, which were thus 6 every four years instead of being always 5 as they had been before.

In fact it replaced the vague year by the sacred year long known to the priests.

But if everything had gone on then as the priests of Tanis imagined, the Egyptian new year's day, *if* determined by the heliacal rising of Sirius, would not always afterwards have been the 1st of Payni, although the solstice and Nile flood would have been due at Memphis about the 1st of Pachons; and this is, perhaps, one among the reasons why the decree was to a large extent ignored.

Hence, for some years after the date of the decree of Tanis there were at least three years in force: the new fixed year, the new vague year, reckoning from Pachons, and the old vague year, reckoning from Thoth.

But after some years another attempt was made to get rid of all this confusion. The time was 23 B.C., 216 years after the decree of Tanis, and the place was Alexandria. Hence the new fixed year introduced is termed the Alexandrine year.

This new attempt obviously implied that the first one had failed; and the fact that the vague year was continued in the interval is sufficiently demonstrated by the fact that the new year was $\frac{2}{4}\frac{6}{0} = 54$ days *en retard*. In the year of Tanis it is stated that the 1st Pachons, the new New Year's Day, the real beginning of the flood, fell on the 19th of June (Gregorian), the summer solstice, and hence the 1st of Thoth fell on the 22nd of October (Gregorian). In the Alexandrine year the 22nd of October is represented by the 29th of August, and the 19th of June by the 20th of April.

It is noteworthy that in the Alexandrine year the heliacal rising of Sirius on the 23rd of July (Julian) falls on the 29th of Epiphi, nearly the same date as that to which I first drew attention in the inscriptions of the date of Thotmes and Pepi. This, however, it is now clearly seen, is a pure accident, due to the break of continuity before the Tanis year, and the *slip* between that and the Alexandrine one. It is important to mention this, because it has been thought that somehow the "Alexandrine year" was in use in Pepi's time!

It would seem that the Alexandrine revision was final, and that the year was truly fixed, and from that time to this it has remained so, and must in the future for ever remain so. It must never be forgotten that we owe this perfection to the Egyptians.

One of the chief uses of the Egyptian calendar that has come down to us was the arrangement and dating of the chief feasts throughout the year in the different temples.

The fact that the two great complete feast calendars of Edfu and Esne refer to the only fixed years evidenced by records, those of Tanis and Alexandria, one of which was established over 200 years after the other, is of inestimable value for the investigation of the calendar and chronology of ancient Egypt.

In an excellent work of Brugsch, "Three Festival Calendars from the Temple of Apollinopolis Magna (Edfu) in Upper Egypt," we have two calendars which we can refer to fixed years, and can date with the greatest accuracy. In the case of one of these, that of Esne, this is universally recognized; as to the other, that of Apollinopolis Magna, we are indebted to the researches of Krall, who points out, however, that "it is only when the province of Egyptian mythology has been dealt with in all directions, that we can undertake a successful explanation of the festival catalogues. Even externally they show the greatest eccentricities, which are not diminished but increased on a closer investigation."

[1] Goodwin has already asked, "Does the Smith Papyrus refer to some rectification of the Calendar made in the 4th Dynasty, similar to that made in Europe from the old to the new style," quoted by Riel, "Sonnen- und Sirius-Jahr," p. 361.

About some points, however, there is no question. The summer solstice is attached in the Edfu calendar to the 6th Pachons, according to Krall, while the beginning of the flood is noted on the 1st of that month. In the Esne calendar, the 26th Payni is New Year's Day. We read:—"26th Payni, New Year's Day, Feast of the Revelation of Kahi in the Temple. To dress the crocodiles, as in the month of Mechir, day 8."

Peculiar to the Esne calendar, according to Krall, is the mentioning of the "New Year's Festival of the Ancestors" on the 9th of Thoth; to the Edfu calendar, publication No. 1 of Brugsch, the festival "of the offering of the first of the harvested fruits, after the precept of King Amenemha I.," on the 1st Epiphi, and "the celebration of the feast of the great conflagration" on the 9th of Mechir. In feast calendar No. 1, the reference to the peculiar Feast of Set, is also remarkable, this was celebrated twice, first in the first days of Thoth (? 9th?), then, as it appears, in Pachons (10th). This feast is well known to have been first mentioned under the old Pharaoh Pepi Merinrā.

It is a question whether in the new year of the ancestors and the feasts of Set, all occurring about the 9th Thoth and Pachons, we have not Memphis Festivals which gave way to Theban ones, for so far as I can make out the flood takes about nine days to pass from Thebes to Memphis, so that in Theban time the arrival of the flood at Memphis would occur on 9th or 10th Thoth. There is no difficulty about the second dating in Pachons, for as we have seen this followed on the reconstruction of the calendar.

It is also worthy of note that the feast of the "Great Conflagration" took place very near the Spring Equinox.

It is well to dwell for a moment on the Edfu inscriptions to see if we can learn from them whether they bear out or not the views brought forward with regard to this reconstruction.

As we have seen it is now acknowledged that the temple inscriptions at Edfu (which are stated to have been cut between 117 and 81 B.C.) are based upon the fixed year of Tanis; hence we should expect that the rising of Sirius would be referred to on 1 Payni, and this is so. But here, as in the other temples, we get double dates referring to the old calendars, and we find the "wounding of Set" referred to on the 1st Epiphi and the rising of Sirius referred to under 1 Mesori. Now this means, if the old vague year is referred to, as it most probably is, that

5 Epacts
30 Mesori

$35 \times 4 = 140$ years

had elapsed since the beginning of a Sothic cycle, when the calendar coincidences were determined, which were afterwards inscribed on the temple walls. We have, then, 140 years to subtract from the beginning of the cycle in 270 B.C. This gives us 130 B.C., and it will be seen that this agrees as closely as can be expected with my view, whereas the inscription has no meaning at all if we take the date given by Censorinus.

I quote from Krall[2] another inscription common to Edfu and Esne, which seems to have astronomical significance.

"1. Phamenot. Festival of the suspension of the sky by Ptah, by the side of the god Harschaf, the master of Heracleopolis Magna (A1). Festival of Ptah. Feast of the suspension of the sky (Es).

"Under the 1st Phamenot, Plutarch, de Iside ac Osiride c. 43, b, notices the ἔμβασις Ὀσίριδος εἰς τὴν σελήνην. These are festivals connected with the celebration of the winter solstice, and the filling of the Uza-eye on the 30th Mechir. Perhaps the old year, which the Egyptians introduced into the Nile valley at the time of their immigration, and which had only 360 days, commenced with the winter solstice. Thus we should have in the 'festival of the suspension of the sky,' by the ancient god Ptah—venerated as creator of the world—a remnant of the time when the winter solstice .... marked the beginning of the year, and also the creation."

The reconstruction of the calendar naturally enhanced the importance of the month Pachons; this comes out very clearly from the inscriptions translated by Brugsch. On this point Krall remarks:—

"It is therefore quite right that the month Pachons, *which took the place of the old Thoth by the decree of Tanis*, should play a prominent part in the feast calendars of the days of the Ptolemies, and the first period of the Empire in general, but especially in the *Edfu* calendar, which refers to the *Tanitic* year. The first five days of Pachons are dedicated in our calendar to the celebration of the subjection of the enemies by Horus; we at once remember the above mentioned (p. 7) record of Edfu of the nature of a mythological calendar, describing the advent of the Nile flood. On the 6th of Pachons—remember the great importance of the sixes in the Ptolemæan records—the solstice is then celebrated. The Uza-eye is then filled, a mythical act which we have in another place referred to the celebration of the solstice, and "everything is performed which is ordained" in the book "on the Divine Birth."

Next let us turn to Esne. The inscriptions here are stated to be based on the Alexandrian year, but we not only find 1st Thoth given as New Year's Day, but 26 Payni given as the beginning of the Nile flood.

Now I have already stated that the Alexandrine year was practically a fixing of the vague Tanis year; that is, a year beginning on 1st Pachons in 239 B.C.

If we assume the date of the calendar coincidences recorded at Esne to have been 15 B.C. (we know it was after 23 B.C. and at the end of the Roman dominion), we have as before, seeing that, if the vague Tanis year had really continued, it would have swept forward with regard to the Nile flood,

Pachons 30
Payni 26

$56 \times 4 = 224$ years after 239 B.C.

This double dating, then, proves the continuation of the vague year of Tanis if the date 15 B.C. of the inscription is about right.

Can we go further and find a trace of the old cycle beginning 270 B.C.? In this case we should have the rising of Sirius

270
− 15

4)255 years

64 = say 5 Epacts and 2 months.

This would give us 1 Epiphi. Is this mentioned in the Esne calendar? Yes, it is, "1 Epiphi. To perform the precepts of the book on the second divine birth of the child Kahi."

Now the 26th Payni, the new New's Year Day, is associated with the "revelation of Kahi," so it is not impossible that "the second divine birth" may have some dim reference to the feast.

It is not necessary to pursue this intricate subject further in this place; so intricate is it that, although the suggestions I have ventured to make on astronomical grounds seem consistent with the available facts, they are suggestions only, and a long labour on the part of Egyptologists will be needed before we can be said to be on firm ground.

J. NORMAN LOCKYER.

[1] On the 7th Epiphi of the 10th year of Ptolemy III. the ceremony of the stretching of the cord took place, Dümichen, Aëg. Z. 2, 1872, p. 41.
[2] *Op. cit.*, p. 37.

PROPOSED HANDBOOK TO THE BRITISH MARINE FAUNA.

THE admirable monographs issued under the auspices of the Ray Society, and in Van Voorst's series, by such well-known authorities as Forbes and Hanley, Alder and Hancock, M'Intosh, Allman, Hincks, Brady, Norman, and others, are amongst the most creditable and useful productions of British Zoology, and all naturalists must devoutly trust that there are still others of a like classical nature to follow, and that, for example, Prof. M'Intosh will soon be able to complete his long-expected work on the British Polychæta.

But many Marine zoologists feel that, quite apart from such exhaustive and expensive monographs, and only aspiring to occupy a very much humbler position, there is pressing need of a "pocket" or seaside "Invertebrate Fauna," which could be used in much the same way as the botanists' "Field Flora." It has been suggested to me more than once during the last few years that I would be doing useful work in compiling such a book; and as no one else seems ready or willing to do so, I feel inclined to make the attempt. Some material has already been accumulated for the purpose, but before going further I wish to lay my views before my fellow zoologists, in the hope that they will be kind enough to criticize the scheme and give me the benefit of their advice.

The only existing work of the kind is Gosse's well-known, and, so far as it goes, very excellent little "Manual of Marine Zoology," but that book does not really meet the present want, as not only is the date of publication 1855-6, since when the number of genera and species has probably been something like doubled, but also Gosse merely gives the names of the species, while the book I think of would, in order to be of any real use, require to aim at giving a brief but sufficient diagnosis and figure of every British species. I would adopt as "British" the area defined by Canon Norman's British Association Committee in 1887.

Probably the most convenient form of publication would be some four to six small volumes, each dealing with one or two of the large groups. This would allow of the groups being published as they were ready, not necessarily in zoological order, and would also be convenient for the use of those interested in one set of animals.

There would be definitions—perhaps with occasional analytical tables or keys—of orders, families, &c., down to and including genera. Under each genus would be given all sufficiently defined species with a brief description of each either in tabular form or in series, as seems most suitable in each case, and with an indication of size, range, and habitat. Many species might be described very briefly in terms of preceding species, the differences merely being pointed out. By simplicity of language, avoidance of unnecessary repetition, and use of contractions it might be hoped that each species could be confined on an average to a couple of lines.

Illustrations would be either in the form of numerous small outline figures on thin paper plates inserted as near as possible to the pages where the descriptions occur, or as small groups of cuts (as in "Gosse") in the text. There would be a figure of the whole animal in each important genus, or small family, and the figures of the species would represent the diagnostic points only, *e.g.* in the zoophytes there would be a figure in the genus *Plumularia* of an entire colony, or shoot, while the species *pinnata*, *setacea*, *catharina*, &c., would be represented each by a small figure showing the pinnæ, calycles, or nematophores as the case required.

I shall now give a few examples, taken from different groups, of the method in which the genera and species might be treated, in order that specialists may have the opportunity of judging and criticizing.

I. From Cœlenterata:—Genus ANTENNULARIA.
Stems simple or branched; pinnæ verticillate; nematophores along the stems; gonothecæ axillary, unilateral.
A. antennina, L., stems clustered, usually simple; hydrothecæ separated by 2 joints. 6 to 9 in. high. Gen. distr. deep w.
A. ramosa, Lamk., stems single, usually branched; hydrothecæ separated by 1 joint only. 6 to 9 in. high. Gen. distr. deep w.

II. From Crustacea:—Family MAIID.E.
HYAS. Carapace tuberculous, no spines; branches of rostrum not divaricated; second joint of antenna dilated; no teeth beneath last joint of walking legs.
H. araneus, L., carapace not contracted behind post-orbital process. 3 in. Common, shallow.
H. coarctatus, Leach, carapace contracted behind post-orbital process. 1 in. Gen. distr. shallow.
PISA. Carapace may be tuberculous, with strong postero-lateral spine; branches of rostrum divaricated at extremity; second joint of antenna slender; terminal joint of walking legs toothed beneath.
P. tetraodon, Leach, carapace with small tubercles: antero-lateral margin with 4 spines. 2 in. Rare, S. coast.
P. gibbsii, Leach, carapace with large rounded elevations, but no tubercles, no spines on antero-lateral margin. Rare, deep w., S. coast.
MAIA. Carapace covered with numerous sharp spines; branches of rostrum strongly divaricated; no teeth beneath terminal joint of walking legs.
M. squinado, Latr. 10 in. long. S. and W. coasts o England.

III. From Tunicata:—Family MOLGULIDÆ.
EUGYRA. Branchial sac with no folds.
E. glutinans. Möll., circular area on side free from sand. ½ in. Shallow w., gen. distr.
E. globosa, Hanc., entirely covered with sand. ½ in.
PERA. Bran. s. with 5 folds each side.
P. hancocki, Hrdn., matted fibres at poster. end. ½ in. Irish Sea, 20 fms.
MOLGULA. Bran. s. with 6 or 7 folds each side.
M. inconspicua, A & H., 6 folds, sandy, dors. lam. entire, no pap. on stigmata. ¼ in.
M. impura, Hel., 6 folds, sandy, small papillæ on edges of stigmata. 1 in. W. of Ireland, shallow.
M. simplex, A. & H., few hairs, little or no sand, 6 folds, anus fringed, dors. tub. horse-shoe, aperture to left. ½–¾ in.
M. tubifera, Örst,, 6 folds, anus fringed, dors. tub. horse-shoe, dors. lam. toothed, sandy. 1 in. E. coast.
M. ampulloides, v. Ben., 6 folds, anus fringed, dors. tub. horse-shoe, 3 bars on fold, dors. lam. entire. 1 in. E. coast, shallow.
M. socialis, Ald., 6 folds, anus fringed, dors. tub. horse-shoe, 4 bars on fold, dors. lam. entire, sandy, gregarious. ½ in. shallow w. S. coast.
M. holtiana, Hrdn., 6 folds, dors. tub. serpentif., hairs but little sand on test. ¾ in. W. of Ireland, 10 fms.
M. occulta, Kupf., 7 folds, dors. tub. horse-shoe, dors. lam. toothed, whole body sandy. 1 in. Shallow w. S. and W. coasts.
M. oculata, Forb., 7 folds, siphonal region alone free from sand, and retractile between folds of test. 1 in. Gen. distr. Shallow w.
M. capiformis, Hrdn., 7 folds, globular, not attached, no sand. ¾ in. S. coast, shallow w.
M. citrina, A. & H., 7 folds, attached by left side, no sand. ½–½ in. under st., litt. E. and W. coasts.
CTENICELLA, as MOLGULA, but branchial and atrial lobes laciniated.
C. complanata, A. & H., 6 folds on left, 7 on right, depressed, attached, sandy, ¼ in.

In conclusion, I need scarcely say that I shall be very grateful for suggestions, and, if the work is carried on, for any information from specialists about less known species, and the discrimination of allied forms, and for specimens, and also for references to any descriptions which might be likely to escape my notice.

W. A. HERDMAN.

NOTES.

IN consequence of the unavoidable absence abroad of the new President of the Institution of Electrical Engineers, Mr. W. H. Preece, F.R.S., on the 12th inst., he will deliver his inaugural address on the 26th inst.

A PUBLIC meeting, arranged by the Technical Instruction Committee of the Essex County Council, will be held in the Shire Hall, Chelmsford, on Friday afternoon, January 13, at 4.30 p.m., Lord Rayleigh in the chair. An address will be given by Sir Henry E. Roscoe on technical instruction in agricultural counties, with especial reference to science teaching. Afterwards a discussion will take place.

DR. PERCY RENDALL, F.Z.S., has accepted an appointment as Resident Medical Officer to the Sheba Gold-mining Company in the Barberton District of the Transvaal. He will reside at Eureka City, at an elevation of 5000 feet above the sea-level. Dr. Rendall made a good collection of birds during his recent residence at Bathurst on the Gambia, of which he has given an account in the *Ibis* for last year (*Ibis*, 1892, p. 215). He has also made many valuable donations to the Zoological Society's Menagerie, amongst which is the unique example of the Nagor Antelope (*Cervicapra redunca*), presented by him in June, 1890. Of this scarce animal there is, we believe, no example in the British Museum. Dr. Rendall's new appointment will give him many opportunities of extending our zoological knowledge of a little known district.

LORD WALSINGHAM, who has devoted much of his attention to the micro-lepidoptera, has filled the vacancy on the staff of the *Entomologists' Monthly Magazine* occasioned by the death of Mr. Stainton.

LAST week a preliminary meeting was held at the house of Sir James Paget to consider what steps should be taken with regard to a memorial of Sir Richard Owen. It was decided that a committee should be formed to make the necessary preparations. The following, among others, have consented to serve as members:—The Presidents of the Royal Colleges of Physicians and Surgeons and of most of the scientific societies, the Duke of Teck, Lord Playfair, Prof. Huxley, Sir Joseph Hooker, Sir Henry Acland, Sir John Evans, Dr. Michael Foster, Mr. Sclater, Sir W. Savory, Mr. Hulke, Sir Joseph Fayrer, Sir Edward Fry, Dr. Günther, Mr. Carruthers and Dr. H. Woodward. Sir William Flower will act as treasurer, and a general meeting will shortly be called. It has been suggested that the memorial should be a marble statue, to be placed in the hall of the Natural History Museum.

PROF. WESTWOOD, who died on Monday at the age of eighty-seven, will be greatly missed at Oxford. To most people he is known chiefly as a writer on the archæology and palæography of art, but he was equally eminent as an entomologist. He was one of the founders of the Entomological Society, and received one of the Royal Society's gold medals for his entomological researches.

WE regret to record the death of General Axel Wilhelmovitch Gadolin, an old member of the Russian Academy of Sciences. He was born of Finnish parents on July 10, 1828, received his education in the Finnish Corps of Cadets, and till his death remained in the Russian Artillery, devoting his leisure time to mineralogical, and especially to mathematical, researches into the molecular forces which act in the formation of crystals. One of his earlier works, published in the *Verhandlungen der Mineralogischen Gesellschaft zu St. Petersburg*, was on some minerals from Pitkäranta. His chief work, published in 1867, was his "Deduction of all the Systems of Crystals and their Derivates from a Unique Principle." A deep impression was produced upon the members of the Russian Mineralogical Society by Gadolin's first communication upon this subject. The lucidity with which he deduced all systems of crystallization from fundamental principles of equilibrium of molecular forces, and the simplicity of the exposition of his researches, entirely based upon high mathematical analysis, reminded his hearers of some of the best pages of Laplace's writings. The work soon became widely known in a German translation. A paper on the resistance of the walls of a gun to the pressure of gunpowder gases also deserves mention, as, in addition to the formerly known formulæ of highest resistance of cylinders, he gave a new formula of minimal resistance. Later on his method was used with great success by Klebsch, in his well-known "Theorie der Elasticität fester Körper," for deducing some general equations of equilibrium of solid bodies.

THE last issue of the *Izvestia* of the East Siberian Geographical Society (vol. xxiii. 3) contains an obituary notice by V. Obrutcheff, of I. D. Chersky, who died in the far north-east of Siberia, during his expedition to the Kolyma river, after having given many years of his life to the active geological exploration of Siberia. He began his work in 1872 at Omsk, where he made most valuable discoveries of post-tertiary mammals. During the next two years he explored the Tunka and Kitoi Alps, but his rich materials were lost during the great conflagration at Irkutsk in 1879. In 1875 and 1876 he explored the Nijneudinsk caves, making again remarkable finds of quaternary mammals; and then he gave fully five years to the study of the stores of Lake Baikal, embodying the results of his extensive researches in a map (6·7 miles to the inch), and in vol. xii. of the *Memoirs* of the East Siberian Society, and vol. xv. of the *Memoirs* of the Russian Geographical Society. In 1882 and 1883 he explored the Lower Tunguska, and again made rich finds of fossil mammals. The next five years he spent at the Academy of St. Petersburg, preparing the part of Ritter's "Asia" which is devoted to Lake Baikal, and working out the rich materials collected by another lamented Polish explorer of East Siberia, Czekanowski. He also worked out the collections brought in from the New Siberia Islands by MM. Bunge and Toll, and came to such interesting and new conclusions as to the recent geological history of Arctic Siberia, that the Academy of Sciences sent him out in 1891, at the head of a new expedition to the Kolyma region. There he died, in the midst of his promising work.

THE twentieth annual dinner of the old students of the Royal School of Mines will be held at the Holborn Restaurant, on Tuesday, January 10, at 7 o'clock. The chair will be taken by Mr. W. Gowland, late of the Imperial Mint, Osaka, Japan.

MR. G. T. ATKINSON has been appointed Professor of Cryptogamic Botany at Cornell University, Ithaca, State of New York, in the place of Prof. W. R. Dudley, who has gone to the Leland-Stanford University, Paolo Alto, California.

AT the next public meeting of the French Academy, in December 1893, forty-five prizes will be awarded for the best work tending to the advancement of the various branches of science. Of these, the following are, by the terms of the bequests, open to competitors of all nationalities. The Prix Lalande will be awarded for the most intereresting observation, or the memoir or work most useful for the progress of Astronomy. Its value is 540 francs. The Prix Valz, of 460 francs, is offered under the same conditions. Three prizes of 10,000 francs each, bequeathed by M. L. La Caze, will be awarded annually for the best contributions to Physiology, Physics, and Chemistry respectively. The Prix Tchihatchef, of 3000 francs, is offered annually to naturalists who have distinguished themselves most in the exploration of the continent of Asia or the adjacent isles

excluding better known regions such as British India, Siberia proper, Asia Minor, and Syria. The explorations must have some object connected with Natural Science, physical or mathematical, and will not be awarded for archæological or ethnographic work. All these prizes will be awarded in December 1893. Works for competition to be sent in to the *Sécrétariat* before June 1. The Prix Leconte, of 50,000 francs, for the most important scientific discovery, will be awarded in 1895.

THE Royal Academy of Sciences of Turin, in accordance with the will of Dr. Cesare Alessandro Bressa, and in conformity with the programme published December 7, 1876, announces that the term for competition for scientific works and discoveries in the years 1889–92, to which only Italian authors and inventors were entitled, was closed on December 31, 1892. The ninth Bressa prize will be given to the scientific author or inventor, whatever be his nationality, who during the years 1891–94, "according to the judgment of the Royal Academy of Sciences of Turin, shall have made the most important and useful discovery, or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology and pathology, as well as geology, history, geography and statistics." The term will be closed at the end of December 1894. The sum fixed for the prize, income tax being deducted, is 10,416 francs. Any one who proposes to compete must declare his intention within the time above mentioned, by means of a letter addressed to the President of the Academy, and send the work he wishes to be considered. The work must be printed. Works which do not obtain the prize will be returned to the authors, when asked for within six months from the adjudication of the prize. None of the national members, resident or not resident, of the Turin Academy can obtain the prize. The Academy gives the prize to the scientific man considered most worthy of it, even if he has not competed.

MESSRS. MACMILLAN AND CO. hope to publish early in the spring the second volume of Dr. Arthur Gamgee's Treatise on Physiological Chemistry. This volume, which deals with the Digestive Processes, will be followed at no long interval by an enlarged and revised edition of the first volume, which originally appeared in 1880.

THE United States Government is inviting the various European Governments to send delegates to an International Conference of Meteorologists, to be held at Washington. The following is said to be proposed as a provisional programme of topics to be discussed by the Conference: (*a*) The organization of additional meteorological work for the benefit of agriculture. (*b*) The extension to all ports frequented by commerce of the benefits of systematic storm and weather signals, and the introduction of a uniform system of storm warnings throughout the world. (*c*) The co-operation of all nations in the publication of a daily chart of the weather over all the habited lands and frequented oceans for the study of the atmosphere as a whole, and as preparatory to the eventual possibility of predicting important changes several days in advance. (*d*) The equable apportionment of stations, publications, and expenses among the nations, and the suggestion of practical methods by which to secure observations from those countries that are not represented in this Conference. (*e*) The encouragement by the respective Governments of special scientific investigations looking to the advancement of meteorology. Such other matters as the delegates may think advisable to submit for discussion, or for future report, will also be considered.

DURING the past week the sharp frost has continued almost uninterruptedly over these islands, with the exception of a partial thaw on Friday and Saturday, caused by a disturbance in the west spreading to the eastward. The greatest increase of temperature occurred in the north and west, but in the south-east of England the day readings were only slightly above the freezing-point. There was a complete change in the type of weather at the close of the week; a large anticyclone had formed over Scandinavia, and the air over nearly the whole of Europe was intensely cold, the minimum in the shade at Haparanda on Sunday registering 72° below the freezing-point, and the barometer on subsequent days rose to 31 inches and upwards in these islands. These conditions were accompanied by cold easterly gales in the south-west of England, while a heavy fall of snow was experienced in the south-eastern districts. On the coast of Kent the shade minimum fell to 11° during Monday night. The *Weekly Weather Report* issued on December 31 shows that the temperature of that period was much below the mean, amounting to 9° or 10° over the greater part of England, and to 12° in the Midland counties. Very little rain fell during the week; the deficiency of rainfall in the south-western district of England for the last year amounts to 10·8 inches, or more than 25 per cent. below the average of the 25 years 1866–90. A good deal of fog was experienced at the inland stations during the week.

SOME very interesting entomological notes from the Eastern Archipelago are given by Mr. J. J. Walker in the January number of the *Entomologists' Monthly Magazine*. Incidentally Mr. Walker mentions that Dr. Wallace's residence in these islands, after a lapse of more than thirty years, is not forgotten, and that the Dutch translation of the "Malay Archipelago" is "as highly appreciated in the lands of which he gives so vivid a picture as the original work is at home."

AT the Physikalisch-Technische Reichsanstalt, Berlin, copies of standard mercury resistances are being constructed in which the mercury does not require renewal (*Wiedemann's Annalen*). They consist of U-shaped tubes filled with mercury in a vacuum and then sealed by fusion. Into each of the ends are fused three thin platinum wires connecting with the main current, the secondary circuit, and the galvanometer respectively. Since the connections are rigidly joined to the glass, it is possible to employ platinum wires as thin as 0·3 mm. so that there is no danger of heat being conducted into the mercury from without. The copy, mounted in a perforated brass box with an ebonite lid, is immersed in petroleum contained in another brass box, so that the binding screws are covered. This box is again surrounded during the experiment with a mixture of fine ice and water. The resistance is thus taken at a temperature which can easily be obtained, and which is uniform throughout the containing vessel.

AN apparatus for demonstrating the difference of potential at the poles of a galvanic cell has been constructed by Messrs. Elster and Geitel, of Wolfenbüttel (*Zeitschr. für Phys. und Chem. Unterricht*). It is a modification of Thomson's water-dropping influence machine. Two insulated metallic vessels can be filled with water by pressing a rubber ball communicating with a three-necked jar. The jets enter the vessels through two metal rings. One of these rings is connected with the positive pole of the cell. The jet on passing through becomes negatively charged, and the charge is communicated to the vessel and through a wire to the second ring, which acts by induction on the other jet. A strong positive charge is soon accumulated on the outside of the second vessel, and can be exhibited by a gold leaf or aluminium foil electroscope.

IN 1869 it was decided, in France, to give a medal and pension of 250 francs to every old soldier of the Republic and the Empire who could show two years of service, or two campaigns, or a wound. An interesting statistical record of these "médaillés de Sainte Hélène" as of "a generation which is disappearing," is given by M. Turquan in the *Revue Scientifique*. The first list, in 1870, comprised 43,592 names; and these men

must have almost exclusively served under the Empire. They are now reduced to 27. The oldest, Vivien by name, a Lyons man, is now 106. When 13 he was with Bonaparte in Egypt, fought in 22 campaigns, and was one of the Imperial Guard at Waterloo. The youngest is 92, and served in the navy. The mean age of the 27 survivors is 97 or 98 years. The annual number of deaths in this body of men reached a maximum of 6456 in 1872, since which year it has been gradually diminishing. The proportional mortality rose, in general, till 1889, but in the years since there has been a marked fall, testifying to the exceptional vitality of those late survivors. M. Turquan calculates that this remnant will have wholly disappeared by the end of the century. Going back to 1815, he estimates the generation to which the men belong at about 300,000, with a mean age of 25 years, and that 500,000 births between 1785 and 1795 would concur to its formation. From figures relating to the Napoleonic wars he comes to the grim conclusion that one man in five of those born between the years just named was destined to die in war. It is, he says, to the immense losses of men during the ten years of war of the Empire that the present generations owe their low birth-rate.

MR. J. R. S. CLIFFORD offers some interesting observations in the January number of *Nature Notes*—the Selborne Society's magazine—on the Death's-head moth and bees. Last July a friend of his at Gravesend found one of these huge moths trying to gain access to a hive, having evidently been drawn to the spot by the odour of the honey. This disposes of doubts which have been suggested as to the old statements about this moth's habit of entering hives when it has a chance. The construction of modern hives keeps it out, but "where old-style hives are used, the moth can and does enter, and occasionally one has been found dead within a hive, the bees, being unable to remove so bulky an insect, having taken the precaution to embalm its body with what is called *propolis*." According to Mr. Clifford, some Continental bee-keepers have discovered that "the bees are aware they are liable to the intrusions of this big moth," and when the bees are "located in the old-fashioned hive, the insects erect a kind of fortification at the portal. This is constructed with a narrow passage and a bend, past which the Death's-head could not possibly make its way, and which it has no jaws to bite through."

WE learn from the *Agricultural Journal*, issued by the Department of Agriculture at Cape Colony, that much attention is being given there to questions connected with the fruit export trade. The department is in correspondence with the steamship companies with a view to securing every possible encouragement to the trade, which is expected to be taken up on a considerable scale this year. Replying to inquiries on the subject, the Castle Mail Packets Company announce that they will give every publicity to the rates of freight to be charged and the stowage arrangements, &c. The Company will also concede a somewhat lower rate for the less remunerative fruits carried in the cool chambers, and will reserve a cool and well-ventilated part of the vessel for conveyance of fruit as ordinary cargo. Careful instructions have been issued to captains of the Company's vessels in regard to the stowage and carriage of fruit.

DR. THEODORE MAXWELL has issued a useful catalogue of Russian medical dissertations and other works he has collected and presented to the Royal College of Surgeons of England. In order that the dissertations may be of service to students who do not read Russian, he has indicated the nature of each work in English, and has given references to such abstracts in the *Lancet* or elsewhere as he has himself made or happens to be acquainted with.

AN excellent "Child Life Almanack" for 1893, by A. M. Clive Bayley, has been published by Messrs. G. Philip and Son. It is issued as an extra number of "Child Life," and the object, as the author explains, is to provide teachers with suggestions both for lessons to be prepared and observations to be made. Teachers who may wish to give "seasonable" lessons will find many most useful hints as to what really goes on in nature during the various periods of the year.

MR. JOHN BROWNING, optical and physical instrument maker, has issued an illustrated catalogue of magic, dissolving view, and optical lanterns, lime-light apparatus, and slides.

THE extraordinary diversity in the temperature at which different micro-organisms flourish and multiply, has from time to time been the subject of some interesting investigations by Fischer, Globig, and others. Thus Fischer isolated fourteen different species of bacteria from the sea-water in Kiel harbour, and from soil in the town itself. These he was actually able to cultivate successfully at the freezing temperature (0° C.) as well as at from 15° to 20° C. Globig, on the other hand, studied the behaviour of micro-organisms at high temperatures and separated out no less than thirty varieties from garden soil which would grow at 60° C. Some of these were even able to develop at 70° C., whilst the majority refused to grow at all below 50° C., some still more fastidious individuals objected to any temperature below 65° C., and others again required a temperature of between 54° and 68° C. One bacillus, however, was discovered more catholic in its taste in this respect, for whilst growing at 68° C. it managed to develop also at from 15° to 20° C. Some fresh contributions on the growth of micro-organisms at low temperatures have recently been made by Forster of Amsterdam ("*Ueber die Entwickelung von Bakterien bei niederen Temperaturen*"). As far back as 1887 Forster described a phosphorescent bacillus obtained from sea-water which was found not only capable of growing, but of producing the phenomenon of phosphorescence at 0° C. In further researches made by this investigator in conjunction with Bleekrode, it is stated that, although not many different species were found by them to develop at 0° C., yet immense numbers of individual bacteria belonging to this category were detected in very various media. Thus one cubic centimetre of milk as sent into the market contained 1000 such micro-organisms, whilst in a single gram of garden soil as many as 140,000 were found. Large numbers of such bacteria were also present in sea-water obtained from the North Sea, and they were also found on the surface of fresh water fish as well as in their alimentary tract. It is well known that to successfully preserve meat and other articles of food it is necessary to employ a much lower temperature than 0° C., and experience has further shown that this is best done when the atmosphere is deprived of all moisture, as is accomplished by the compression and subsequent expansion of the air in enclosed spaces. Haddocks imported from Norway and thus artificially frozen were examined by Forster for bacteria. These fish were first killed and then exposed to a temperature of from 20° to 40° below 0° C. until they became perfectly hard and stiffly frozen, when they were removed to a cold chamber in which the temperature varied from 8° to 15° below 0° C. In spite of the extremely low temperature to which these fish had been subjected, on examining them when still hard frozen, a considerable number of bacteria were found in the abdominal cavity which had been opened when the fish was killed. It is obvious that during the interval which elapsed between the killing of the fish and their transference to the freezing chamber, bacteria must have been able to gain access, but had not had time to multiply to any considerable extent before the fish was frozen. Forster points out, what is sufficiently apparent, that the packing of samples of water in ice when sent from a distance

for bacteriological examination to prevent the multiplication of the micro-organisms present, is really of very little if any use at all. Thus it was already shown several years ago by Percy Frankland that the bacteria in filtered Thames water were able to multiply extensively, even when preserved for some days in a refrigerator.

THE additions to the Zoological Society's Gardens during the week include a Bittern (*Botaurus stellaris*), European, presented by Lord Ilchester, F.Z.S.; two Hamsters (*Cricetus frumentarius*), British, presented by Miss Pugh; two Alligators (*Alligators mississippiensis*), from Florida, presented by Master Williams; a Common Snipe (*Gallinago cælestis*), British, purchased.

OUR ASTRONOMICAL COLUMN.

COMET HOLMES (NOVEMBER 6, 1892).—The following is a continuation of Herr Berberich's ephemeris of this comet, the places being for Berlin, midnight:—

		R.A.	Decl.	Log *r*.	Log Δ.
		h. m. s.	° ′		
Jan.	5 ...	1 8 50 ...	+33 47·9 ...	0·4119 ...	0·3400
	6 ...	9 59 ...	46·4		
	7 ...	11 8 ...	45·0		
	8 ...	12 18 ...	43·7		
	9 ...	13 30 ...	42·6 ...	0·4143 ...	0·3516

The comet is now near to and south following β Andromedæ. Reports from various Observatories state that the comet is now very dim.

COMET BROOKS (NOVEMBER 20, 1892).—This comet is now travelling very quickly. The ephemeris for Berlin, midnight, is continued below:—

		R.A.	Decl.	Log *r*.	Log Δ.	Br.
		h. m. s.	° ′			
Jan.	5 ...	18 29 40	+66 5·4 ...	0·0805 ...	9·8562 ...	7·82
	6 ...	19 0 49 ...	13·6			
	7 ...	19 31 22 ...	65 59·2			
	8 ...	20 0 22 ...	24·6 ...	0·0806 ...	9·8651 ...	7·49
	9 ...	20 27 8 ...	64 32·4			
	10 ...	20 51 19	+63 26·0 ...	0·0811 ...	9·8781 ...	7·01

The unit of brightness is taken as that at midnight on November 21.

The track of the comet lies near the pole of the ecliptic, in the constellation Draco.

THE SPECTRUM OF COMET HOLMES.—The spectrum of the comet appears to have been continuous without any trace of bright bands. At South Kensington it appeared to have its brightest part near the chief carbon fluting (λ 517), but there was nothing which could be described as a line or fluting. As might be expected, there was a brighter continuous spectrum from the nucleus. The same result was obtained by Mr. Campbell at the Lick Observatory, and by Prof. Keeler at the Allegheny Observatory. The latter observer remarks that the spectrum is just what we should expect if the comet shines entirely by reflected sunlight.

THE RECENT OPPOSITION OF MARS.—In the December number of *Astronomy and Astro-Physics*, Prof. W. H. Pickering summarizes the conclusions derived from the observations of Mars at Arequipa as follows: (1) That the polar caps are clearly distinct in appearance from the cloud formations, and are not to be confounded with them. (2) That clouds undoubtedly exist upon the planet, differing, however, in some respects from those upon the earth, chiefly as regards their density and whiteness. (3) There are two permanently dark regions upon the planet, which under favourable circumstances appear blue, and are presumably due to water. (4) Certain other portions of the surface of the planet are undoubtedly subject to gradual changes of colour, not to be explained by clouds. (5) Excepting the two very dark regions referred to above, all of the shaded regions upon the planet have at times a greenish tint. At other times they appear absolutely colourless. Clearly marked green regions are sometimes seen near the poles. (6) Numerous so-called canals exist upon the planet, substantially as drawn by Prof. Schiaparelli. Some of them are only a few miles in breadth. No striking instances of duplication have been seen at this opposition. (7) Through the shaded regions run certain curved branching dark lines. They are too wide for rivers, but may indicate their courses. (8) Scattered over the surface of the planet, chiefly on the side opposite to the two seas, we have found a large number of minute black points. They occur almost without exception at the junctions of the canals with one another and with the shaded portions of the planet. They range from thirty to one hundred miles in diameter, and in some cases are smaller than the canals in which they are situated. Over forty of them have been discovered, and for convenience we have termed them lakes.

The heights of some of the clouds were found to be not less than twenty miles, and indirect observations have led to the conclusion that the density of the atmosphere of the planet is less than that at the surface of the earth, but probably not as much as ten times less.

Prof. Pickering is of opinion that the opposition of 1894 will be quite as valuable to observers as that of 1892, the distance being but little greater, while the planet will be much farther north, and there is less likelihood of the surface being so much obscured by clouds as during the recent opposition.

GEOGRAPHICAL NOTES

AN interesting illustration of the rapid development of South Africa is given by the recent appointment of a magistrate to reside near Lake Ngami to protect the interests of white traders, and enforce the laws restricting the sale of liquor and ammunition to the natives.

THE January number of the *Geographical Journal*, the new form of the Proceedings of the Royal Geographical Society, contains a paper and map of some importance by Mr. A. P. Harper, descriptive of the central part of the Southern Alps of New Zealand. Government surveyors have been sent for several seasons to map out the glaciers, and an effort is being made by thoroughly exploring and mapping the region to make it the Switzerland of the southern hemisphere in the estimation of tourists, as it is already by virtue of its fine mountain systems.

AN important paper on the physical conditions of the waters of the English Channel is published by Mr. H. N. Dickson in the new number of the *Scottish Geographical Magazine*. He shows how the ebb and flow of the tides in the Channel is affected by the characteristic form of the main feature of the coast-line, viz. bays with the western side running nearly from south to north, turning at a sharp angle, and lying open to the east. The circulation of the water and its temperature were found to be largely determined by these conditions.

MR. COLES gave a successful lecture to young people in the hall of the University of London, on Friday last, covering the first half of his subject, "All the World Over," in a very interesting way. Anecdotes of personal adventure combined with exceptionally fine limelight views of scenery to give a vivid impression of the regions touched upon. The second and last juvenile lecture, under the authority of the Royal Geographical Society, will be given on Friday, January 6, at 4 p.m.

THE Royal Scottish Geographical Society announces a course of educational lectures in continuation of those delivered by Prof. J. Geikie and Dr. H. R. Mill last year. The new course will be on the Geographical Distribution of Animals, by Mr. J. Arthur Thomson, who is at present delivering the Thomson Lectures at Aberdeen. The Society has also provided two special lectures to young people, by Prof. C. G. Knott, on Life in Japan, and by Mr. Graham Kerr on his recent travels in South America.

WE understand that a book of travel in Madagascar and Africa, by Mrs. Colvile, F.R.G.S., describing the observations of the authoress on a recent extensive tour, will shortly be published by Messrs. Blackwood.

MR. J. W. GREGORY, assistant in the Geological Department of the British Museum, has joined as naturalist the sporting expedition of Lieutenant Villiers and others, which is on the point of starting up the Juba. From Bardera, the head of navigation, the party will traverse unknown regions to Lake Rudolf, and from there attempt to cross in a north-easterly direction, through the Galla country and Somaliland to Berbera, on the Gulf of Aden.

THE INTERNATIONAL ZOOLOGICAL CONGRESS AT MOSCOW.

THE International Zoological Congress held its second session in Moscow during the month of August last, and with most commendable zeal the committee, to whose care the editing and publishing of the memoirs read were committed, now publish the first part of the volume of its Proceedings. This part is printed in royal octavo size, and contains 350 pages, with several illustrations. All the memoirs are in French, thirteen out of the total thirty having been translated from, it is presumed, Russian. In the first section—that of questions concerning biology and systematic and faunistic zoology from a general standpoint—there are three papers. J. de Kennel replies to the queries of Prof. L. Cosmovici: (1) On a definite arrangement of the animal kingdom in "Phyla"; (2) is there a type "Vermes"? (3) on a uniform terminology of the secretory organs of worms. Ch. Girard on some points of nomenclature. J. de Bédriaga on introduced species, and on hybrids, reptilian and amphibian. In Section II.—the same subjects from a special standpoint—there are twelve papers:—P. N. Boutchinsky, on the Black Sea fauna; refers to a report on invertebrates of the Bay of Sebastopol by Péréiaslavtzeva, who records 639 forms found. He describes three zones: (1) from the surface to a depth of 175 feet; (2) from 175 to 280 feet in depth, with a minimum temperature of 6–7° C.; and (3) from 280 to 700 feet, with a slightly higher temperature than in the previous zone, 8–9° C. From a depth of 700 feet the water contains a quantity, more or less large, of sulphureted hydrogen, the quantity notably increasing with the depth. T. J. Van-Beneden gives a note on the living and extinct Cetacea of the same sea. Gr. Kojevnikov gives an account of the fauna of the eastern Baltic based on many recent explorations. Dr. J. de Bédriaga treats of European and circum-mediterranean vipers. C. Grévé has a paper on the geographical distribution of the Carnivores, and T. Richard, one on the geographical distribution of the Cladocerous crustacea. H. de Jhéring makes some observations on insects' nests made of clay. Prof. A. Brandt gives a classification of animal variations according to their causation. Prof. A. Milne Edwards and E. L. Bouvier give a most interesting account of the varieties and distribution of *Parapagurus pilosimanus*, S. T. Smith. A table with the comparative measurements of forty-two specimens, is appended. *P. abyssorum* and var. *scabr*, are reduced to the first named species. F. Vejdovsky describes *Thuricola gruberi*, n. sp., and *Monodontophrya longissime*, gen. et sp. nov., the former from a stream near Bodenbach, the latter in the alimentary tract and body cavity of *Rhynchelmis limosella*, Hofm. In a short note Dr. J. de Bédriaga calls attention to some differences between *Chalcides simonyi*, Steind., and *C. viridanus*, which forms Boulenger and Steindacher have proposed to unite, and thinks that *Molge luschani*, Steind., neither belongs to Molge nor to Salamander, but to a European and American genus, not however named by him.

The third section contains eight papers on histology and embryology. N. Kholodovski, contributions to a mesoderm and metamere theory. A. Ptitzine, note on the formation of the germ of the peripheric nervous system. V. Roudnev, note on the development of the cardiac endothelium in Amphibians. Mme. O. Tikhomirova, on the development of *Chrysopa perla*. Fr. Vejdovsky, on the segmentation of the ovum and the formation of the blastoderm in the Pseudoscorpiones, and on a rudimentary organ in the same. N. Koulaguine, contribution towards the history of the parasitic hymenoptera. A. Tikhomirov, value of embryological research for classification. Section IV., physiology:—C. Khvorostansky, on the luminosity of animals from the White Sea.

In Section V., devoted to morphology and comparative anatomy, L. Cosmovici writes as to the purport of the "aquiferous system," "segmentary organs," "excretory organs," and "nephridia." H. de Jhéring, on the presence or absence of an excretory apparatus in the genital organs of the metazoa. P. Mitrophanov, note on the metameric significance of the cranial nerves. N. Nassonov, on the position of the Strepsiptera in the animal system, according to the facts of post-embryonal development and of anatomy. A. O. Kovalevsky, on the excretory organs of the terrestrial Arthropods. N. Zograf, on the origin and parentage of the Arthropous, more especially the tracheal bearing forms.

A BOTANIST'S VACATION IN THE HAWAIIAN ISLANDS.

THE new number of the American *Botanical Gazette* (vol. xvii., No. 12) contains the first part of a paper by Prof. D. H. Campbell, describing his experiences during a vacation spent last summer in the Hawaiian Islands. We reprint the following passage:—

On awakening upon the seventh day out, and looking through the port-hole of my state-room, I saw that we were sailing near land. Rugged barren looking hills were seen; and, going upon deck, I learned that this was Oahu, the island upon which Honolulu is situated. As we skirted the shore at a distance, I soon spied a grove of unmistakable cocoa palms, the first hint of the tropical vegetation to which I was soon to be introduced. Beyond was the bold promontory of Diamond Head, an extinct volcanic crater, forming a great bowl with rugged sides, right at the water's edge. Beyond this, and bounded partly by it, is the bay upon whose shores stands the city. Back of it rose abruptly a chain of mountains, in places about three thousand feet above sea-level, and furrowed by deep valleys, whose walls, as well as the cloud-capped summits of the hills, were covered with the most wonderfully verdant vegetation. Never before had I realized the possibilities of green. Blue greens, yellow greens, gray greens, and positive greens, with all degrees of these and others that are indescribable, combined to form what Whistler would term a symphony in green.

As if to vie with the colours of the mountains, the sea exhibited an equally wonderful variety of tints. Outside the harbour is a coral reef, and within this the water is of the pale green common to shallow ocean water; but outside it deepens very rapidly into the vivid blue of the open ocean. From a distance the line is clearly seen; but, as the observer approaches shore, the water changes from deep blue through every shade of blue and green until the pale green of the water within the harbour is reached.

As we approached land numbers of the queer outrigger canoes of the natives were met, and from the wharf boys jumped into the water and swam about the ship in the hope of persuading some of the passengers to throw over to them coins, which they were very skilful in diving for.

On the way to the hotel a few gardens were passed, and in them everything was strange. By far the most striking thing was the superb *Poinciana regia*. Although I had never seen this before I recognized it in an instant from a description of Charles Kingsley's, read long ago. Surely in the whole vegetable kingdom there is no more splendid plant. A spreading flat-topped tree, perhaps thirty feet high, with feathery green, acacia-like foliage and immense flat clusters of big flaming scarlet flowers that almost completely hide the leaves so that the tree looks like an immense bouquet. They were in their prime about the time of my arrival in Honolulu, and continued to flower more or less for the next six weeks. Pretty much everything in Honolulu, except the cocoanuts and an occasional haw tree (*Paritium tiliaceum*) is planted; but people seem to vie with each other in seeing how many different kinds of plants they can grow, and the result is that the place is like one great botanical garden. To Dr. Hillebrand this is said to be largely due, as he was one of the first to introduce foreign ornamental plants, and his place, which is kept much as it was at the time he left the islands, was a very remarkable collection of useful and ornamental plants from the warm regions of almost the whole globe.

Probably the first thing that strikes the traveller from the cooler regions is the great variety and number of palms. Of these the beautiful royal palm (*Oreodoxa regia*) is easily first. With its smooth columnar trunk, looking as if it had been turned, encircled with regular ring-shaped leaf-scars, and its crown of plumy green leaves, it well deserves its name. Other characteristic palms are various species of betel palms (Areca), wine palm (Caryota), sugar palm (Arenga), and a great variety of fan-palms of different genera. None is more beautiful than a thrifty young cocoa palm, but unfortunately it is very subject in the Hawaiian Islands to the ravages of some insect which eats the leaves and often renders them brown and unsightly. Indeed, it is almost impossible to find a specimen which is not more or less disfigured by this pest. The trunk of the cocoanut tree is usually more or less crooked, and in old specimens much too tall

for its thickness, so that the old trees look top-heavy. The date palm flourishes in Honolulu, where it is quite dry, but does not do so well in the wetter parts of the islands.

On studying the other trees, one is struck at once by the great preponderance of Leguminosæ, especially Cæsalpineæ and Mimoseæ. All about the town, and growing very rapidly, is the algaroba (*Prosopis juliflora*), a very graceful tree of rapid growth, with fine bipinnate leaves and sweetish yellow pods, which animals are very fond of, and which are used extensively for fodder. Add to this that the tree now forms the principal supply of fuel for Honolulu and we can realize its full value. Other leguminous trees that are planted are the monkey-pod (*Pithecolobium samang*), tamarind, various species of Bauhinia and Cathartocarpus. One species of the latter with great drooping bunches of golden yellow flowers and enormous cylindrical pods three or four feet long, rivals the Poinciana when in full flower.

Mingled with these are a great number of shrubs and trees with showy flowers or leaves, most of them more or less familiar to the stranger, either from pictures or from green-house specimens. Several species of Musa are grown, and when sheltered from the wind are most beautiful; but ordinarily the leaves are torn into rags by the wind. The tall and graceful *M. sapientium* has been largely supplanted by the much less beatiful Chinese banana, *M. Cavendishii*, which is short and stumpy in growth, but enormously prolific. The related traveller's tree (*Ravenala Madagascariensis*), is a common and striking feature of many Hawaiian gardens. Of the many showy flowering shrubs, the beautiful *Hibiscus Rosa-Sinensis* is one of the commonest, and is used extensively for hedges. One of the most striking hedges in the city, however, is the famous one at Puna Hou college, which is 500 feet long and composed of night-blooming cereus. I was not fortunate enough to see this when it was in full flower, but I saw a photograph of it when it was estimated that there were about 8000 flowers at one time.

Of the fruit trees ordinarily grown, the following may be mentioned. The mango is a very handsome tree with dense dark green foliage and masses of yellow and reddish fruit on long hanging stalks. The bread-fruit tree is common, both cultivated and wild, and is a very beautiful tree of moderate size, with leaves looking like immense fig-leaves, and the fruit like a large osage orange. I saw no ripe fruit, and so had not an opportunity of testing its quality. Guavas of different varieties are extremely common, both wild and cultivated, and the various fruits of the whole citrus tribe grow well. The few specimens of temperate fruits were, for the most part, much inferior to those of the United States. Of the fruits that did not strike my fancy, at least at first, was the alligator pear (*Persea gratissima*), a big green or purple pear-shaped fruit with an immense single seed. The pulp is somewhat waxy in consistence and very oily. It is eaten as a salad, and very much relished by the islanders, but the taste is acquired. The curious papaya (*Carica papaya*) is another fruit which did not appeal to my palate. Its big orange fruit, not unlike a melon in appearance when cut open, has a peculiar "squashy" flavour that suggested it having been kept a day too long.

Many showy climbers are planted, some of which, like Stephanotis, Thunbergia and Allamanda are superb; but there is one that is particularly obnoxious in colour, Bougainvillea, whose magenta floral-bracts are an offence to the eye, forming a cataract of raw colour. It looks, as some one observed, as if it had just come from a chemical bath.

As soon as one gets fairly away from the city, it is at once seen that all the luxuriant vegetation is strange. Along the seashore is a plain gradually rising into low hills, both almost destitute of trees, except here and there a few cocoa palms along the shore. Of the strictly littoral plants among the most conspicuous is the curious *Ipomœa pes-capræ*, with deeply two-cleft leaves and purplish pink flowers. In the fertile lowlands near the sea are the principal cane and rice fields, which with taro are the staple crops. The rice is cultivated entirely by Chinese, near Honolulu; but on the sugar plantations the Japanese are largely employed. To see a Chinese laboriously transplanting little handfuls of rice into straight rows, or ploughing in the mud and water with a primitive plough drawn by a queer Chinese buffalo are sights very foreign to an American eye. Sugar cane is eminently productive in the islands, and, hitherto, has proved the main source of revenue; but now the Hawaiians are bewailing the depression caused by the free admission of sugar from other countries into the United States; as, hitherto, their product has enjoyed practically a monopoly of the American market, having been admitted by treaty free of duty.

I made several trips up the valleys back of the city, but owing to the almost constant rain in many of them, these were not always agreeable. However, one is richly repaid by the luxuriance and variety of the vegetation. For a mile or two we pass between grass-covered hills, or hills overgrown in places with the lantana, which, introduced as an ornamental plant, has become a great pest. This plant covers some of the hills with an absolutely impassable thicket, and spreads very rapidly, so that it is a serious problem what is to be done with it. Of the common roadside plants, an orange and yellow milkweed and the showy white *Argemone Mexicana* were the most conspicuous. As one proceeds farther, where more moisture prevails, the variety becomes larger. Thickets of Canna and a Clerodendron with double rosy-white flowers, are common, and the curious screw-pine (*Pandanus odoratissimus*) is occasionally seen. This latter is a very characteristic plant, but is much more abundant in some of the other islands. In this region some very showy species of Ipomœa are very common, among them the well-known moon-flower, *I. bona-nox*.

With the increase in moisture, as might be expected, the mosses and ferns increase in number and beauty. There are many of them of types quite different from those of the United States. One of the commonest ferns of the lower elevation in *Microlepia tenuifolia*, a very graceful fern with finely divided leaves and terminal sori. Species of Vittaria, with very long undivided leaves, are also common here.

As we ascend one of the commonest ferns is *Sadleria cyatheoides*, a very large fern, often more or less arborescent. Ascending still higher the number and variety of ferns increases rapidly, and many beautiful and interesting ferns and mosses and liverworts become common.

At about one thousand feet elevation we begin to meet with species of Cibotium, to which genus belong the largest of the tree ferns of the islands. Here, also, I met for the first time with the smallest of all the ferns I have ever seen, *Trichomanes pusillum*. This dainty little fern, one of the Hymenophyllaceæ, forms dense mats on rocks and tree-trunks, looking like a delicate moss. The full-grown frond is fan shaped, and, with its stalk, is not more than half an inch high. These tiny leaves, nevertheless, in many cases bore sporangia.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 8.—"Preliminary Account of the Nephridia and Body Cavity of the Larva of *Palæmonetes varians*." By Edgar J. Allen, B.Sc., University College, London. Communicated by Prof. W. F. R. Weldon, F.R.S.

The Green Gland, in a larva of *Palæmonetes* which is a few days old, consists of an end-sac, which communicates by means of a U-shaped tube with a very short ureter, opening at the base of the second antenna. At the time of hatching, the gland consists of a solid mass of cells, without a lumen. In later stages the tube of the gland enlarges to form the bladder. The enlarged bladders of the two sides subsequently meet and fuse in the middle dorsal line, forming the nephroperitoneal sac described by Weldon and Marchal.

The Shell Gland is found in late embryos and young larvæ of *Palæmonetes*. It consists of a short renal tube, with a considerable lumen, which communicates internally with an end-sac, and opens externally at the base of the second maxilla.

Sections through the anterior region of the thorax of *Palæmonetes* show that the body cavity may be divided into four regions: a *dorsal sac*, surrounded by a definite epithelium, in which the cephalic aorta lies, but which does not itself contain blood; a *central cavity*, containing liver, intestine, and nerve-cord; two *lateral cavities*, containing the proximal ends of the shell glands; and fourthly, the *cavities of the limbs*, which contain the distal ends of the same organs.

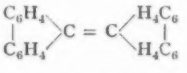
In late embryos of *Palæmonetes* solid masses of cells lie upon either side of the cephalic aorta. The dorsal sac is formed by the hollowing out of these masses of cells. Two lateral cavities are thus formed, which are separated by the aorta. The protoplasm of the cells lining these cavities, which is at first gathered into masses around the nuclei, then spreads out into a thin sheet, drawing away from the lower portion of the aorta, and causing the two lateral cavities to unite ventrally, and so form a single sac.

In the posterior region of the thorax the central and lateral cavities are similar to those of the anterior region, whilst dorsal to them the pericardial chamber lies. This chamber is separated from the central body cavity by the pericardial septum. The genital organs are situated immediately below the front end of this septum.

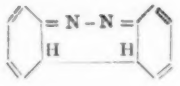
A comparison with the body cavity of *Peripatus* suggests the following relations. In the anterior region of the thorax of *Palæmonetes* the dorsal sac is homologous with the dorsal portions of the mesoblastic somites of *Peripatus*, and its cavity is a true cœlom. The central and lateral cavities, together with the cavities of the legs, represent the pseudocœle. In the posterior region of the thorax the cavities are all pseudocœlomic, and agree with those of the adult *Peripatus*.

December 15.—"Preliminary Note on the Relation of the Ungual Corium to the Periosteum of the Ungual Phalanx." By F. A. Dixey, M.A., M.D., Fellow of Wadham College, Oxford. Communicated by E. A. Schäfer, F.R.S.

Chemical Society, December 1.—Prof. A. Crum Brown, President, in the chair.—The following papers were read:—The isolation of two predicted hydrates of nitric acid, by S. U. Pickering. The author announces the isolation of two crystalline hydrates of nitric acid: the monohydrate and the trihydrate, melting at $-36{\cdot}8^{\circ}$ and $-18{\cdot}2^{\circ}$ degrees respectively. In the case of either the melting-point is lowered by the addition of acid or water. The existence of these compounds was foreseen from an examination of the curves plotted from Bertholet and Thomsen's heat of dissolution values. This result is an important confirmation of the author's views.—Anhydrous oxalic acid, by W. W. Fisher. The best method of obtaining crystallized anhydrous oxalic acid is by allowing the hydrated acid to remain in contact with concentrated sulphuric acid for some months in a sealed glass tube. Oxalic acid is soluble in about 30 parts of cold sulphuric acid; the anhydrous acid dissolves with absorption of heat, whilst the reverse is the case with the hydrated acid. Anhydrous oxalic acid may be crystallized from nitric acid of sp. gr. 1·5. Oxalic acid may be completely dehydrated in a vacuum at 60°; the anhydrous acid is soluble in ethyl oxalate or glacial acetic acid, and separates from these solvents in a powdery form.—The production of orcinol and other condensation products from dehydracetic "acid," by N. Collie and W. S. Myers. The authors have obtained orcinol by the action of barium hydrate on dehydracetic "acid" or dimethylpyrone; on boiling a mixture of syrupy caustic soda and dehydracetic "acid," a true carboxylic acid is first produced, and, losing carbonic anhydride, yields orcinol. Among the products of the interaction of barium hydrate and diacetylacetone bright yellow needles melting at 180–181° are found; these probably consist of a naphthalene derivative $C_{11}H_{14}O_3$. Amidodehydracetic "acid," obtained in long needles melting at 192–196°, by the action of strong ammonium hydrate on dehydracetic "acid," readily yields dehydracetic "acid," on acid or alkaline hydrolysis.—Observations on the origin of colour and on fluorescence, by W. N. Hartley. It cannot be stated in general terms that colour is due to special methods of atomic arrangement; the statement may, however, be applied in a restricted sense to certain organic compounds, especially to those included in the class to which organic dye-stuffs belong. It is pointed out that all open chain hydrocarbons exert a continuous absorption, the extent of which depends on the number of carbon atoms in the molecule. The condition of strain and instability existing in many coloured substances has been remarked by Armstrong; the author points out that all organic colouring matters are endothermic compounds, and considers this to be the physical cause of what Armstrong terms "reactivity" or "high potential." It is shown that anthracene is not colourless, but has a true greenish-yellow colour in addition to its fluorescence. A number of experiments on fluorescence are detailed, and the following conclusions drawn from them:—(1) Alcoholic solutions of quinine exhibit a beautiful, bright violet fluorescence. (2) Hydrochloric acid is not fluorescent. (3 and 4) Quinine hydrochloride and chloroform are feebly fluorescent, but without distinct colour. (5) Both hydrochloric acid and chloroform can extinguish those rays which are the cause of fluorescence in quinine. (6) Some alkaloids may be recognized by the degree and colour of their fluorescence. (7) Normal alcohols of the ethylic series and the fatty acids are fluorescent. (8) Glycerol has a violet fluorescence. (9) Benzene has a pale blue fluorescence, azobenzene a greenish-blue. (10) Rock crystal has a pale bluish-violet fluorescence, flint glass a strong blue, and crown glass a very brilliant blue fluorescence. (11) Substances which are not fluorescent in strong solutions may become so on dilution, particularly if they exert a very powerful absorption of the ultra-violet or invisible spectrum.—The origin of colour, v. coloured hydrocarbons and fluorescence: a reply to Prof. Hartley's observations on the origin of colour and of fluorescence, by H. E. Armstrong. If attention be paid to visibly-coloured organic substances, it is a most remarkable fact that in those cases in which the "constitution" is fairly well established coloured substances are found to be all of one type. The author starts from this basis to inquire whether all coloured organic substances are not similar in type. Hartley's remark that all organic colouring matters are endothermic compounds has little importance in the present connection, inasmuch as the converse does not hold. The author contends that before admitting the fluorescence of many substances, *e.g.* alcohol and its homologues, every precaution must be taken to ensure their purity; instances in which easy explanation of the fluorescence of certain substances is possible are given. Hartley's observation that anthracene is coloured strongly confirms the author's hypothesis. Anthracene is fluorescent, and may be represented by a quinonoid formula, whilst its isomeride phenanthrene, which cannot be so represented, is colourless and non-fluorescent. Furthermore, whilst intense colour is produced by "weighting" what the author terms the "quinonoid radicles" of anthracene by replacing the central hydrogen atoms by a halogen, no such effect attends the similar treatment of phenanthrene, dibromophenanthrene being colourless like the hydrocarbon. And yet anthraquinone and phenanthraquinone are coloured yellow and deep orange respectively. Reference is made to other coloured hydrocarbons, viz. carotin and the red hydrocarbon, $C_{26}H_{16}$, recently investigated by Graebe. The formula assigned to the latter by Graebe—

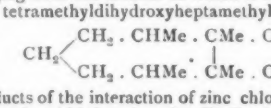


—is an improbable one; such a substance would be colourless. The author gives a possible constitution, and, for the present, proposes to call the compound "erythrophene." The yellow hydrocarbon, $C_{26}H_{16}$, obtained together with this, is possibly a diphenylated anthracene, and may be termed "xanthophene." The "quinonoid radicles" in both hydrocarbons are heavily "weighted," hence their strong colour. With reference to Hartley's statement that a very little shifting of the region of absorption determines the presence or absence of colour in a compound, it is contended that this shifting may be due to a special character of structure. The author then explains his views as to the manner in which the "quinonoid mechanism" conditions colour. He suggests that in quinonoid compounds there are two "colour centres" corresponding to and expressed by the symbol ⊃ in formulæ such as he has used in representing coloured substances. These centres co-operate in producing colour through interaction of the light waves which traverse them. Substances in which there are no such co-operating centres may absorb generally and selectively in "ultra" or "infra" regions of the spectrum, but without exhibiting "visible colour."—The origin of colour, vi. azobenzene, by H. E. Armstrong. Azobenzene, a highly-coloured substance, is generally represented as Ph.N : N.Ph, a formula in disaccord with the author's hypothesis explained in the preceding paper. Moreover, the formulæ usually attributed to the colourless diazo-salts (Ph.N : N.Cl, for example) represent them as comparable in constitution with azobenzene. The behaviour of azobenzene towards bromine and other reagents leads the author to doubt the correctness of the conventional formula assigned to it, and to consider the following a more probable one:—



—The reduction products of dimethyldiacetylpentane, by F. S. Kipping. The author shows that dimethyldiacetylpentane, a diketone produced by the hydrolysis of ethyl dimethyldiacetylpimelate is converted by reduction with sodium in a moist ethereal solution into dimethyldihydroxynonane and a compound

which, judging from the manner in which it is formed, may be regarded as tetramethyldihydroxyheptamethylene.



—The products of the interaction of zinc chloride or sulphuric acid and camphor (third notice), by H. E. Armstrong and F. S. Kipping. The authors have previously shown that the crude product obtained on heating camphor with sulphuric acid or zinc chloride contains 1 : 2 : 4 acetylorthoxylene. On oxidizing the oil remaining after the separation of the latter substance, α-methylglutaric acid is formed. This acid being the characteristic oxidation product of the phorone obtained by distilling calcium camphorate, it is probable that a homologue of this phorone is present in the camphor product.—The Griess-Sandmeyer interactions and Gattermann's modification thereof, by H. E. Armstrong and W. P. Wynne. In employing the Griess-Sandmeyer methods for displacing the amido-group by halogens, the authors find that, in very many cases, much better results may be obtained by operating at relatively low temperatures instead of at the boiling point. It appears also that the Gattermann process affords a larger yield than the Sandmeyer process, only because it is carried out at a lower temperature.—Methods of observing the spectra of easily volatile metals and their salts, and of separating their spectra from those of the alkaline earths, by W. N. Hartley. Persistent flame colourations of easily volatile metals, such as lithium, potassium, rubidium, cæsium, and thallium, may be obtained by heating beads of their fluosilicates, borates or silicates, on platinum wires in the Bunsen flame. If the substance to be spectroscopically examined be converted into a borate, the spectra of the alkali metals may be first observed, and on subsequently passing hydrogen chloride into the flame, the spectra of the alkaline earth metals may be rendered visible.—Manganese borate, its constitution and properties, by W. N. Hartley and H. Ramage. Manganese borate, after drying *in vacuo* over sulphuric acid has the composition $MnH_4(BO_3)_2.H_2O$. On heating at 100° it loses one molecule of water, and at a red heat two molecules more of water are lost, leaving a salt of the composition $Mn(BO_2)_2$. From the rate of loss of water with rise of temperature the existence of a number of intermediate salts is inferred. Manganese borate possesses a maximum of solubility in water at 18°, and a minimum at 80°. This is probably due to dehydration of the compound having the composition $MnH_4(BO_3)_2.H_2O$.

Anthropological Institute, December 13.—Edward B. Tylor, President, in the chair.—Mr. Arthur J. Evans read a paper on the prehistoric interments of the Bahi Rossi caves near Mentone and their relation to the Neolithic cave-burials of the Finalese. He described the recent discovery of three skeletons in the cave of Barma Grande, and showed that the character of the sepulchral rites practised, the relics found, and the racial type of the human remains agreed with the earlier discoveries made by M. Rivière and others in the same caves. Mr. Evans, however, opposed the theories that had been put forward as to the Palæolithic date of "Mentone Man." The bones of extinct Pleistocene animals and implements of the Moustier and Magdalenian types found in the cave earth above the interments proved nothing, for the simple reason that they were interments. No remains of extinct animals had been found in actual juxtaposition with the skeletons. On the other hand the complete absence of pottery, of polished implements, and of bones of domesticated animals in this whole group of interments and the great depth at which they occurred proved that the remains belonged to a very early period. Evidence was here supplied of an earlier Neolithic stage than any yet authenticated. Still the remains belonged to the Later Stone Age and to the days of a recent fauna. Mr. Evans compared some bone ornaments found with the so-called hammer-heads of the chambered barrows of Scandinavia and the decorative system with that found on Neolithic pottery in northern Europe. He further showed that interments of the same tall dolichocephalic race in a more advanced stage of Neolithic culture were to be found in the cave-burials of the Finale district further up the Ligurian Coast. The physical form and the character of the sepulchral rites was essentially the same. Only the skeletons were here associated with polished axes, pottery, and bones of domesticated animals. The direction from which the new civilizing influences had come was indicated by imported shell ornaments from the southern and eastern Mediterranean; in the Mentone caves the imported shells were from the Atlantic. In conclusion Mr. Evans showed that the latter Finale interments exhibited forms of pottery and implements identical with those of the Italian terremare of the other side of the Apennines, and included ceramic shapes which seemed to be the prototypes of vessels found in the early Sikel tombs of Mycenæan age. The Italic culture here revealed fitted on not only to that of the early pile-settlements of the Po Valley and the Lake-dwellings of Switzerland, but might be traced to the Danube valley, to Thrace, and the Troad. Amongst other parallel forms owl-like idols bearing a strong resemblance to those described by Dr. Schliemann from the site of Troy had been found by Padre Morelli of Genoa in one of the Finale caves.—Dr. H. Colley March read a paper in which he sought to prove that the peculiar features of Polynesian ornament are due to a mythography which is, in the main, a symbolism of origin and descent. Thus regarded, unattractive and bewildering designs are resolved into emblems of divinity and demonstrations of lineage. He traced the evolution and defined the attributes of Tiki, explained the nature of oromatuas and the meaning of unus, described the various methods of recording pedigrees, whether along a male or along a female line, and illustrated the mythical use of tapa and sinnet. He discussed, as modes of origin, totemism, gemmation, and generation, of which Polynesian examples were given, tabulated the kinship of the superior gods, set forth in full the Tane cult, especially in relation to the axe and the drum, and endeavoured, in conclusion, to account for the development of the complicated Mangaian adze.

EDINBURGH.

Royal Society, December 5.—Sir Douglas Maclagan, President, in the chair.—After an introductory address by the President, a note by Prof. Cayley, on uniform convergency of series, was read.—Prof. Tait communicated a note by Prof. P. H. Schoute, of Groningen, on the locus of a uniformly revolving line, which always passes through a point moving uniformly round a circle, and which always lies in a normal plane passing through the centre of that circle. The degree of the locus is found by an elegant and very simple method.—Dr. C. Hunter Stewart gave notice of a paper on the further development of Kjeldahl's method of organic analysis. The carbon, as well as the nitrogen, present can be determined by the same analysis in the developed method, and much smaller quantities than formerly of the substance analyzed lead to results as accurate as those previously obtained.—Prof. Tait read a note on the division of space into cubes. He gives a different, and more direct and short, solution by quaternions than that given by him some years ago.

PARIS.

Academy of Sciences, December 26.—M. d'Abbadie in the chair.—Thermal elevation under the influence of injections of soluble microbian products, by MM. Bouchard and Charrin. An elevation of temperature recalling that observed by Koch is produced in a marked degree in tuberculous patients by injections of the toxic substances secreted by the pyocyanic bacillus.—Vessels and clasmocytes of the hyaloid in the frog, by M. Ranvier.—Observations of Holmes's comet (November 6, 1892) made with the great equatorial of the Bordeaux Observatory, by MM. G. Rayet and L. Picart, report by M. Rayet.—Observations of Swift's comet (1892, I.) made with the great equatorial of the Bordeaux Observatory, by MM. G. Rayet, L. Picart and F. Courty, report by M. Rayet.—On the laws of dilatation of fluids at constant volume; coefficients of pressure, by M. E. H. Amagat.—Observations of Holmes's comet, made with the *equatorial coudé* (32 cm.) of the Lyon Observatory, by M. G. Le Cadet.—New experimental researches on the personal equation in transit observations, by M. P. Stroobant.—On conjugate systems and couples of applicable surfaces, by M. A. Petot.—On infinitesimal deformation and Bianchi's associated surfaces, by M. E. Cosserat.—On contiguous surfaces relative to the hypergeometrical series with two variables, by M. Levavasseur.—Test for the convergence of series, by M. A. de Saint-Germain.—Criterion of divisibility by any number, by M. Fontés.—On the motion of a particle in the case of a resistance proportional to the velocity, by M. Elliott.—General form of the law of vibratory motion in an isotropic medium, by M. E. Mercadier.—Employment of springs in the measurement of explosive pressures. If errors due to the inertia of the moving parts of the indicator are to be avoided, the amplitude of the

tracing point must not exceed 1 mm. in the case of pressures used in modern firearms. This necessitates careful reading with a microscope.—On the decrease of temperature of the air with the elevation, by M. Alfred Angot. Experiments conducted on the Eiffel Tower indicate a decrease for each 100 m., between the soil and a height of 160 m., ranging from 0·6° in December to 1·46° in June. Between 160 m. and 302 m. the decrease per 100 m. ranges from 0·64° in February to 0·96° in October. At 300 m. the decrease per 100 m. is on the average 0·5° in winter, 0·6° in autumn, 0·7° in spring, and 0·8° in summer.—On the temperature of the electric arc, by M. J. Violle. From calorimetric measurements made with a portion of the arc light carbon detached from the hottest part during the passage of the current, the temperature of the arc, *i.e.* that of the volatilization of carbon, appears as 3500°, assuming the carbon to have its theoretical specific heat, 0·52, at the higher temperatures. This temperature of volatilization is constant, whatever the power employed.—Remarks on high temperatures and the vaporization of carbon, by M. Berthelot. The vapour tension of carbon is quite appreciable even below volatilization, which involves the reduction of a polymer to the monomolecular state, thus in reality representing a chemical process. Higher temperatures than that of the arc can be attained by purely chemical means, such as the explosive combustion of a mixture of oxygen and cyanogen.—On the equality of velocities of propagation of electric waves in air and along conducting fibres, verified by the example of a large metallic surface, by MM. Ed. Sarasin and L. de la Rive.—On nets of electric conductors; reciprocal properties of two branches, by M. Vaschy.—On the enfeeblement of electromagnetic oscillations with their propagation and their subsidence, by M. A. Perot.—Determination of the coefficients of self-induction by means of electrical oscillations, by M. P. Janet.—Doppler-Fizeau's method, exact and approximate formulæ, evaluation of the error involved, by H. de la Fresnaye.—Magnetic properties of oxygen at different temperatures, by M. P. Curie. A series of measurements with oxygen compressed to 5 and to 18 atmospheres respectively gave identical results at temperatures between 20° and 450°. Within this range, the volume coefficient of specific magnetization of oxygen varied inversely as the absolute temperature. The volume coefficient of magnetization of air at the ordinary pressure and at temperature t is given by $10^6 k_t = 2760 \times T^{-2}$, where T is the absolute temperature.—On the rotatory power of quartz at low temperatures, by MM. Ch. Soret and C. E. Guye.—On the fusion of carbonate of lime, by M. A. Joannis.—Ammoniacal compounds derived from ruthenium sesquichloride, by M. A. Joly.—On an iodo-sulphide of phosphorus, by M. L. Ouvrard.—Action of bismuth on hydrochloric acid, by MM. A. Ditte and R. Metzner.—Action of potash and soda on the oxide of antimony, by M. H. Cormimbœuf.—Relation between the heats of formation and the temperatures of the point of reaction, by M. Maurice Prud'homme.—On the study of the chemical reactions in a liquid mass by the index of refraction, by M. C. Féry.—On a propylamidophenol and its acetyl derivatives, by M. P. Cazeneuve.—Quantitative determination of impurities in the methylenes, by M. Er. Barillot.—Separation of micro-organisms by centrifugal force, by M. R. Lezé.—Loss of nitrogen in manures, by MM. A. Müntz and A. Ch. Girard.—Fermentation of manure, by M. A. Hébert.—Drying-up of marshes in Russia, by M. Venukoff.—Chemical conditions of the action of ferments, by M. J. Effront.—On trichophytia in man, by M. R. Sabouraud.—Evolution of the functions of the stomach, by M. J. Winter.—On the histology of the organs attached to the male apparatus in *Periplaneta orientalis*, by M. P. Blatter.—On the presence of a fossil Araliacea and Pontederiacea in the coarse Parisian limestone, by M. Ed. Bureau.—On a new geological map of the French and Spanish Pyrenees, by MM. Emm. de Margerie and Fr. Schrader.—Differential motion of the ocean and the atmosphere; water tides and air tides, by M. F. de Saintignon.—On the perforation of the basaltic rocks of the Gulf of Aden by shingle; formation of a Giant's Kettle, by M. Jousseaume.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, JANUARY 5.

ROYAL INSTITUTION, at 3.—Astronomy: Sir Robert S. Ball, F.R.S.

LONDON INSTITUTION, at 6.—Jewish Wit and Humour: The Rev. the Chief Rabbi.

SATURDAY, JANUARY 7.

ROYAL INSTITUTION, at 3.—Astronomy: Sir Robert S. Ball, F.R.S.

SUNDAY, JANUARY 8.

SUNDAY LECTURE SOCIETY, at 4.—In Search of Pharaoh—Ancient Egypt: its Temples, Pyramids, Monuments, and Mummies (with Oxy-hydrogen Lantern Illustrations): Whitworth Wallis.

MONDAY, JANUARY 9.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Qualitative Analysis of Colouring Matters: A. G. Green.—The Proportion of Free Fatty Acids in Oil Cakes: Dr. B. Dyer.—Further Notes on Nitrous Oxide: Watson Smith.

ARISTOTELIAN SOCIETY, at 8.—The Psychology of the Subconscious: A. Boutwood.

LONDON INSTITUTION, at 5.—Social Pictorial Satire (Illustrated): G. du Maurier.

TUESDAY, JANUARY 10.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—A Contribution to the Ethnology of Jersey: Dr Andrew Dunlop.—Points of Contact between Old World Myths and Customs and the Navajo Myth, entitled "The Mountain Chant": Miss A. W. Buckland.

WEDNESDAY, JANUARY 11.

GEOLOGICAL SOCIETY, at 8.—Variolite of the Lleyn and Associated Volcanic Rocks: Miss Raisin. (Communicated by Prof. T. G. Bonney, F.R.S.).—On the Petrography of the Island of Capraja: Hamilton Emmons. (Communicated by Sir Archibald Geikie, For.Sec.R.S.

THURSDAY, JANUARY 12.

MATHEMATICAL SOCIETY, at 8.—On the Application of Clifford's Graphs to Ordinary Binary Quantics; 2nd Part, Seminvariants: The President.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Experimental Researches on Alternate-Current Transformers: Prof. J. A. Fleming, F.R.S. (Discussion.)

LONDON INSTITUTION, at 6.—Electric Lighting (1) Generation of Electric Currents: Prof. Silvanus Thompson, F.R.S.

FRIDAY, JANUARY 13.

PHYSICAL SOCIETY, at 5.—Upon Science Teaching: F. W. Sanderson.

AMATEUR SCIENTIFIC SOCIETY, at 8. Geology in 1892: A. M. Davies.—Recent Developments in the Metallurgy of Gold: T. K. Rose.

SATURDAY, JANUARY 14.

ROYAL BOTANIC SOCIETY, at 3.45.

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